YUKON RIVER TECHNICAL REPORT

1988

prepared by

The Joint Canada/United States
Yukon River Technical Committee

February 23-25, 1988

Anchorage, Alaska

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1.0 Introduction

The Chief Negotiators for the U.S. and Canadian delegations to the Yukon River Salmon Negotiations directed the Joint Technical Committee (JTC) to address the following topics prior to the March 1988 negotiations:

1) Stock Specific Harvest Management Strategies

   The Technical Committee will examine various approaches for directing fishing effort in the Yukon River on specific stocks or groups of stocks of chinook and fall chum salmon. Although harvest management strategies are required for both chinook and fall chum salmon, the initial emphasis will be on chinook.

2) Stock Rebuilding

   The Technical Committee will review and consolidate information presented in previous reports on stock rebuilding scenarios for Yukon River chinook and fall chum salmon.

3) Enhancement

   The Technical committee will carry out a general evaluation of enhancement opportunities for chinook and fall chum salmon on the Yukon River.

4) Population Estimates from the Canadian Mark-Recapture Program

   Canada will comment on a U.S. review of the mark-recapture program operated at the Canada/U.S. border and designed to estimate the number of chinook and fall chum salmon moving into the Canadian portion of the Yukon River watershed.

5) Information on 1987 season data not previously reported.

6) Exchange of special data requested at October 1987 JTC meeting.

The JTC met in Anchorage at the office of the Alaska Department of Fish and Game (ADF&G) from February 23 to February 25, 1988. Table 1 lists persons attending the JTC meeting.

The Appendix (see List of Appendix Figures and Tables) includes a series of tables and figures that present comparative catch and escapement data through 1987.

Table 1. Members of the Joint Canada/US Yukon River Technical Committee.[1/]

Alaska Department of Fish and Game

Ron Regnart (co-chair)
Richard Randall
Linda Brannian
Larry Buklis
Craig Whitmore
Fred Andersen

United States Fish and Wildlife Service

Dick Marshall
Rod Simmons

National Marine Fisheries Service (U.S.)

Aven Andersen

Department of Fisheries and Oceans (Canada)

Mike Henderson (co-chair)
Sandy Johnston
George Cronkite
Robin Harrison (absent)
Gordon Zealand
Terry Beacham

Yukon Territorial Government

Mark Hoffman

1/ The following ADF&G staff members were present for a portion of the meeting but are not JTC members: Richard Cannon, John Wilcock, Dan Bergstrom

2.0 Stock Specific Harvest Management Strategies

2.1 Migratory Timing

In the interest of examining various approaches for directing fishing effort on specific salmon stocks, information was presented on the migratory timing of salmon runs in the lower Yukon. Figures 1, 2, and 3, depict the migratory timing of chinook salmon runs or stocks at the lower Yukon test fishing site during 1982-1986. Since commercial fishing is restricted to only a few days during the salmon migration, test fishing catches provide the only continuous time series of data from the time the river is free of ice (late May - early June) through July 15. Several data sets were combined to produce this information. Estimates of commercial catch stock composition generated from a scale patterns analysis study by ADF&G which distinguishes among chinook salmon spawning stocks from three broad geographical areas (lower, middle and upper river) were applied to test fish catch per unit effort. Table 2 summarizes migratory timing differences among these stocks by comparing mean dates of entry. Methods used to produce this information are described in an unpublished ADF&G report (Brannian, in press).

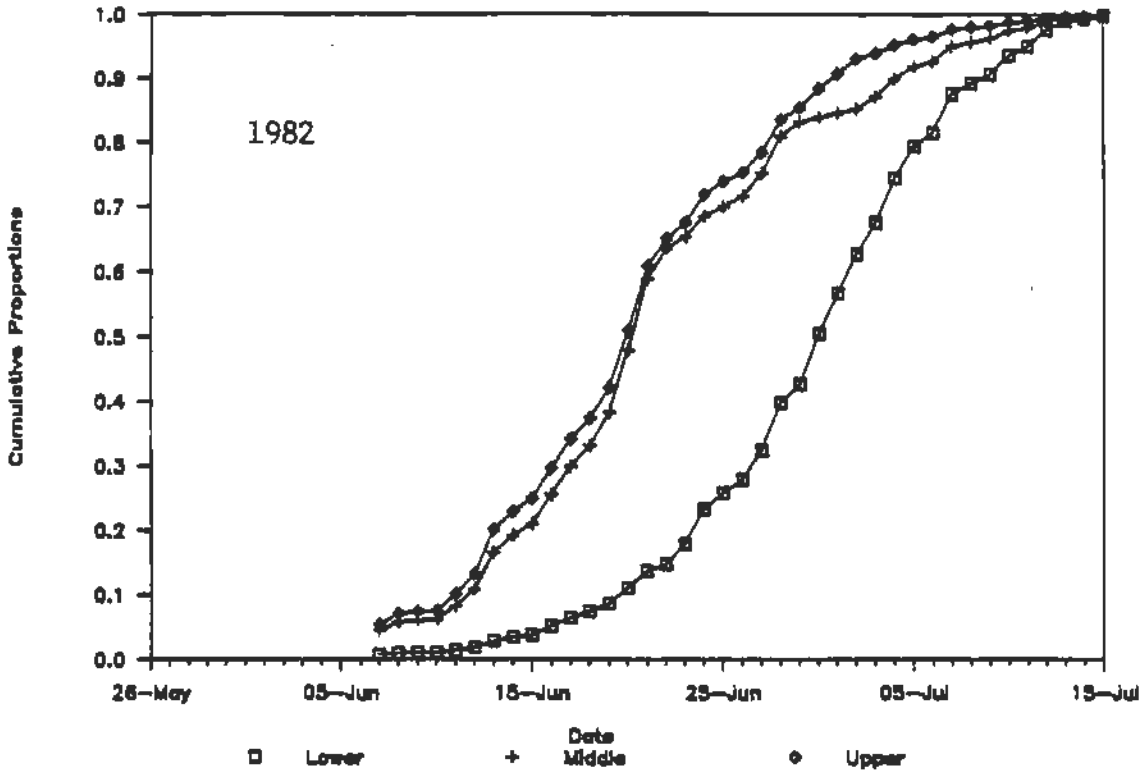
The migratory timing for middle and upper river stocks was very similar with their mean dates of entry differing by less than 1 day in 1983 and 1984 to 4.2 days in 1985. The middle river stock had the earliest timing during three years (1983, 1984 and 1985), while the upper river stock had a slightly earlier timing during 1982 and 1986. The lower river stock consistently had the latest migratory timing of all stocks during the 1982-1986 period.

The differences in migratory timing among all stocks were small in 1984, 1985 and 1986. For example, the mean date of entry for the latest occurring stock (lower river) was about 2 days different than that for the next latest stock.

In 1982 and 1983 there was greater temporal separation between the lower river stock and the other two stocks. For example, there was 9 and 11.5 days separating the mean dates of entry between lower and upper river stocks in 1982 and 1983 respectively.

Figure 4 compares the migratory timing of summer chum and chinook salmon in the lower Yukon during 1981-1986. With the exception of 1981, both species had very similar migratory timing.

Based on five years of data, it appears that the annual differences in migratory timing among chinook salmon stocks are variable and unpredictable, although there is a general pattern of middle and upper river stocks arriving in numbers before lower river stocks. Adjustments in fishing time to selectively harvest



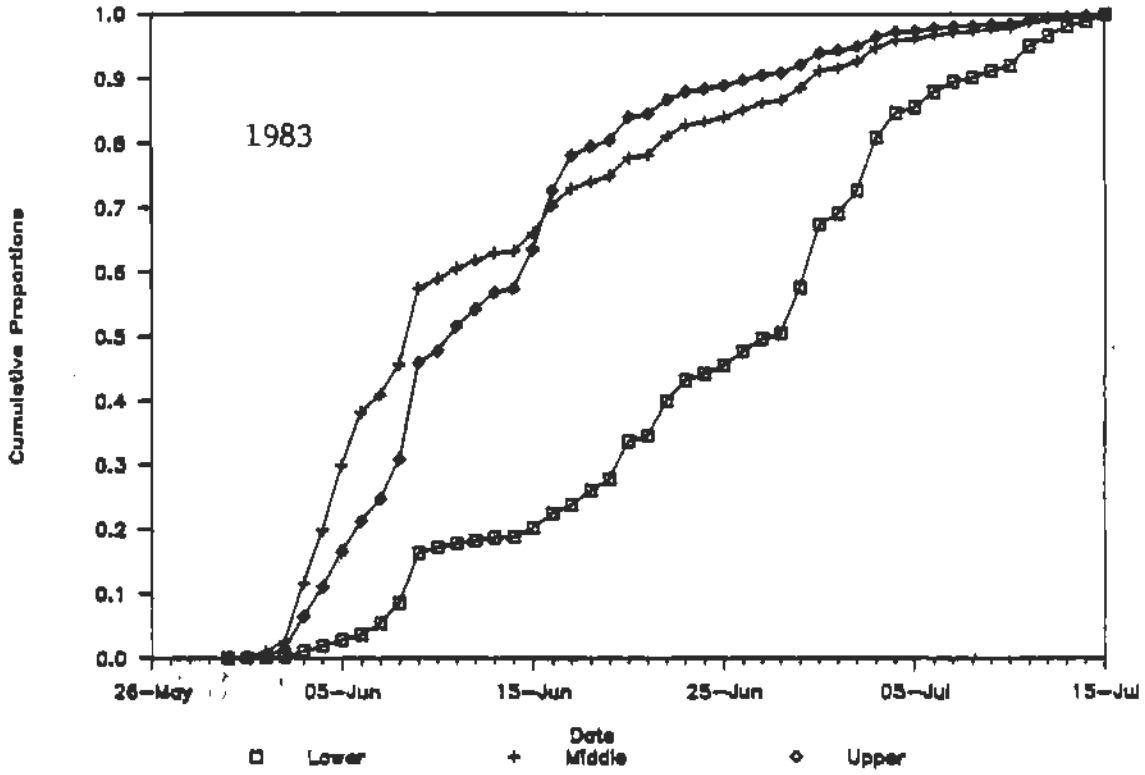


Figure 1. Cumulative proportions of total chinook salmon CPUE by date and run (lower, middle, and upper) for the Lower Yukon River test fishery for 1982 (top) and 1983 (bottom).

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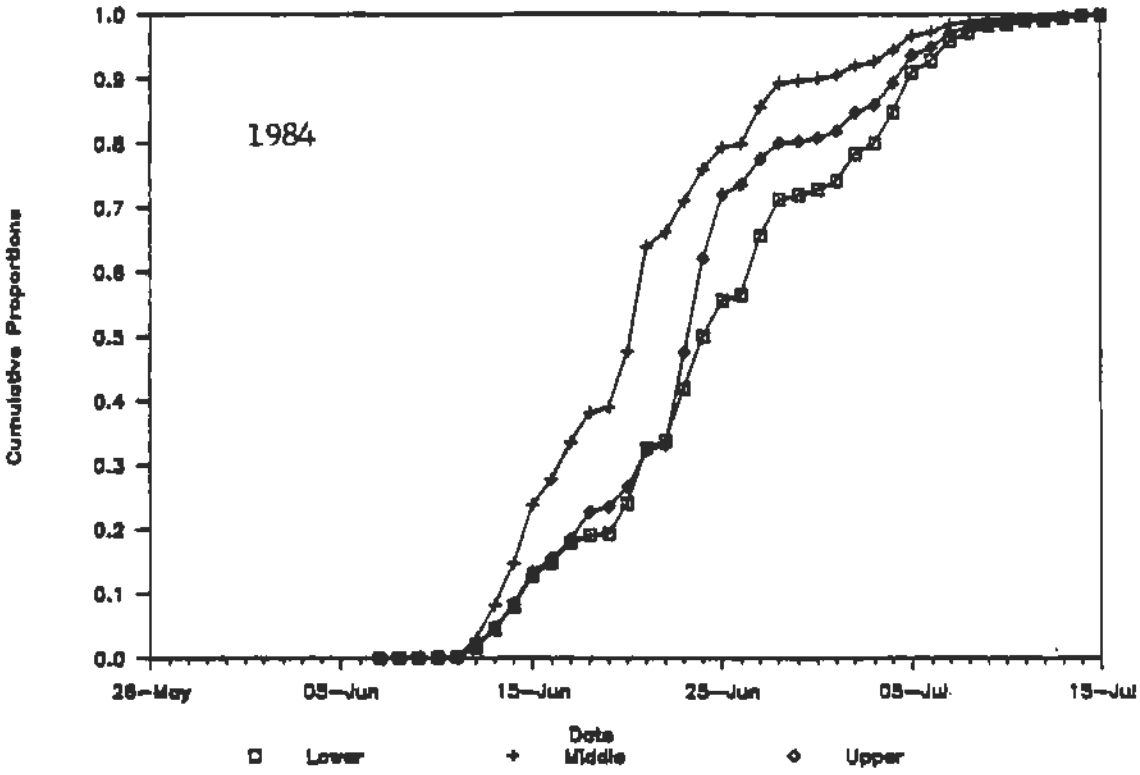

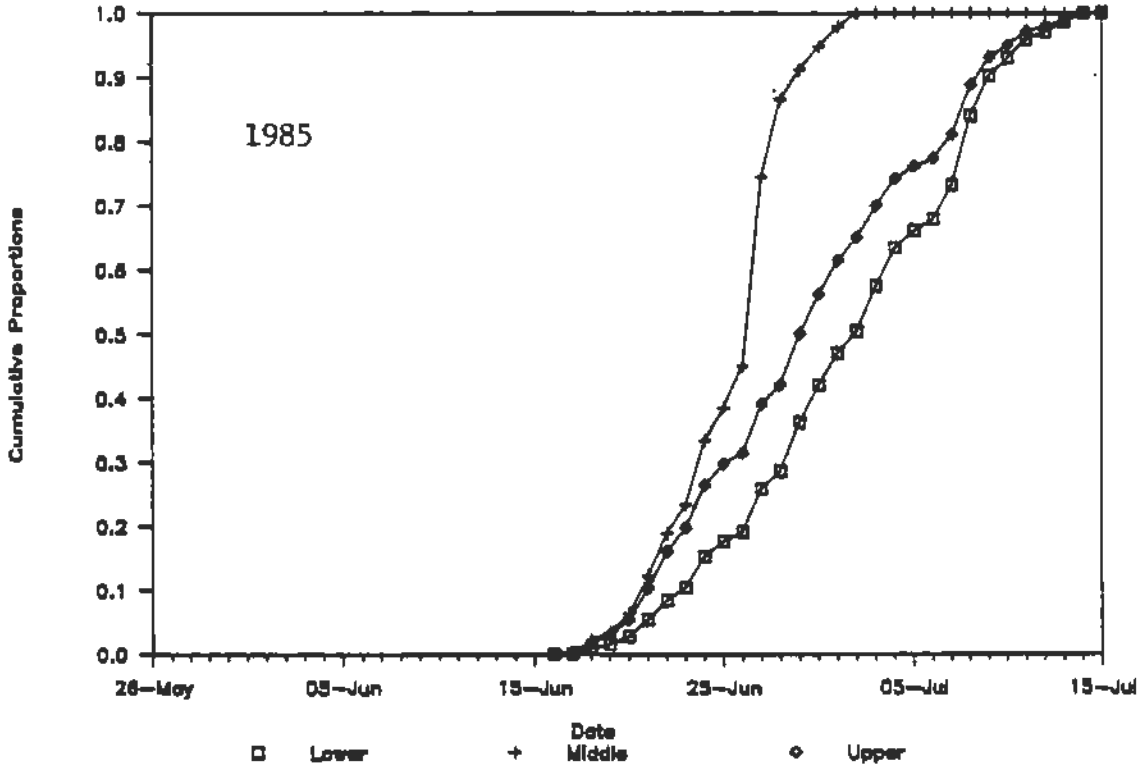

Figure 2. Cumulative proportions of total chinook salmon CPUE by date and run (lower, middle, and upper) for the Lower Yukon River test fishery for 1984 (top) and 1985 (bottom).

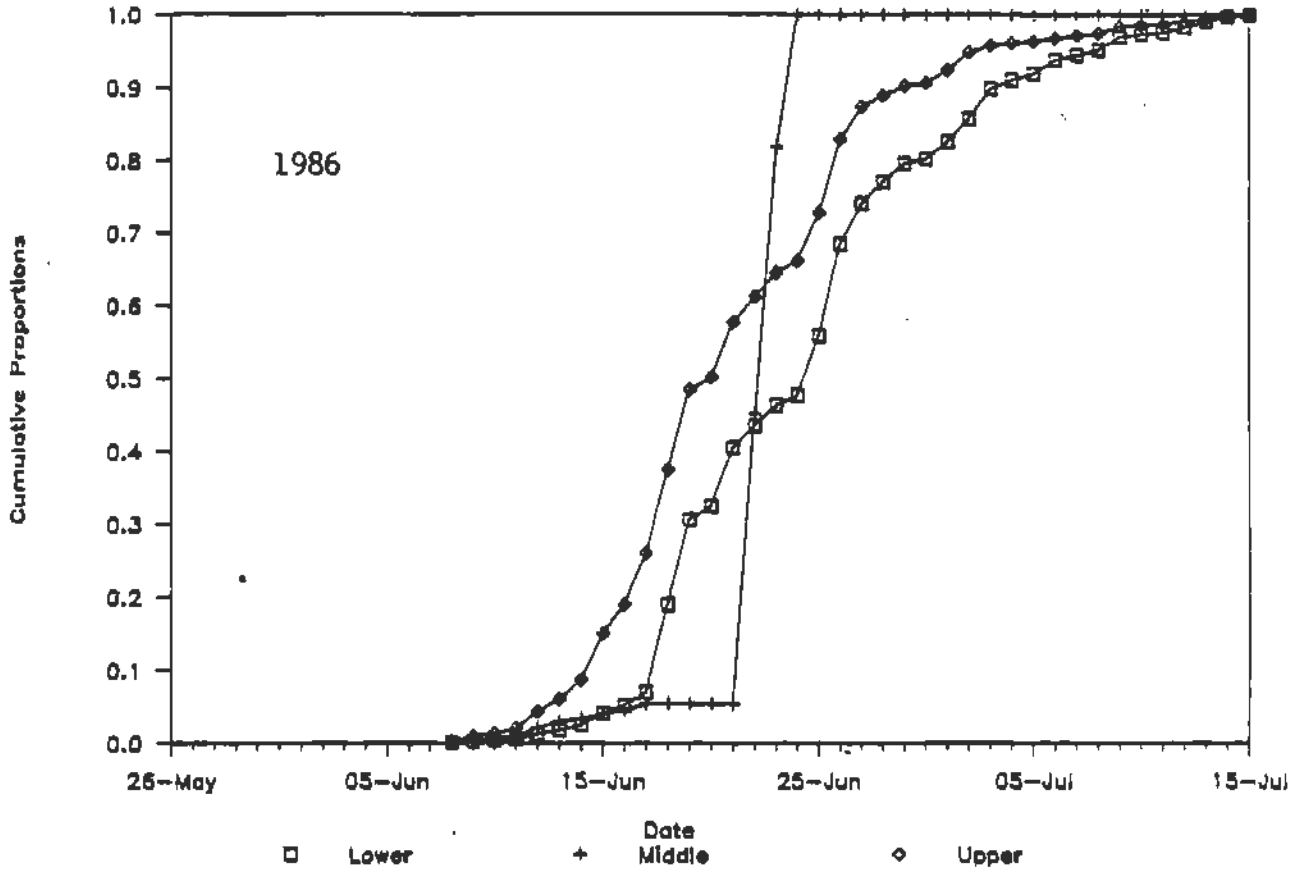

Figure 3. Cumulative proportions of total chinook salmon CPUE by date and run (lower, middle, and upper) for the Lower Yukon River test fishery for 1986.

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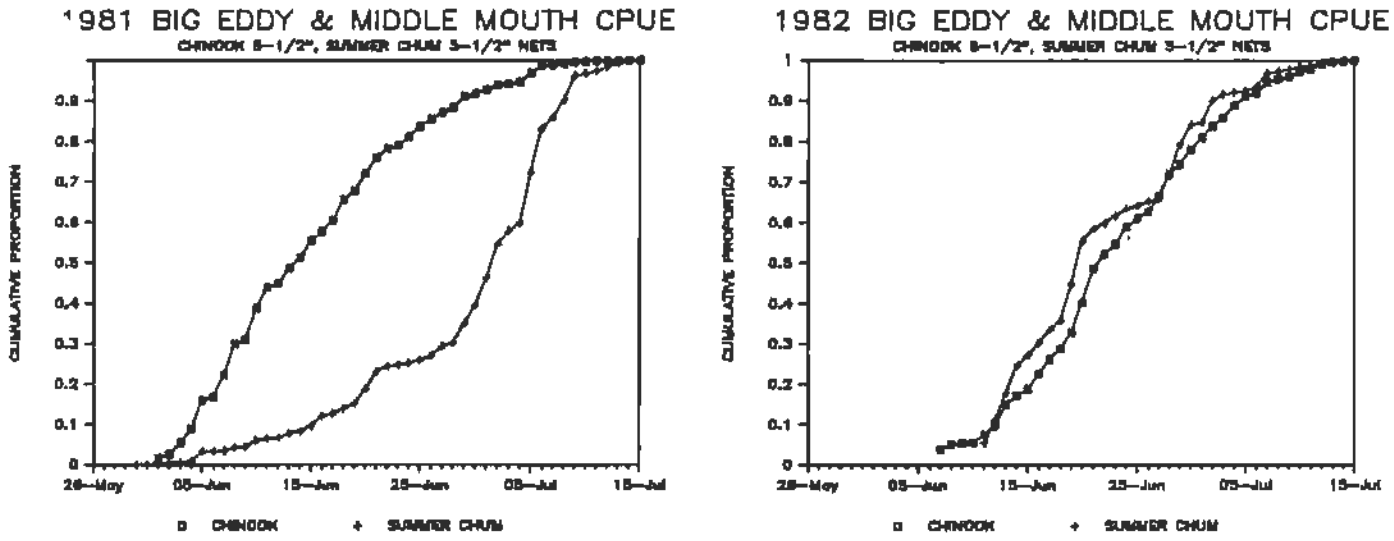
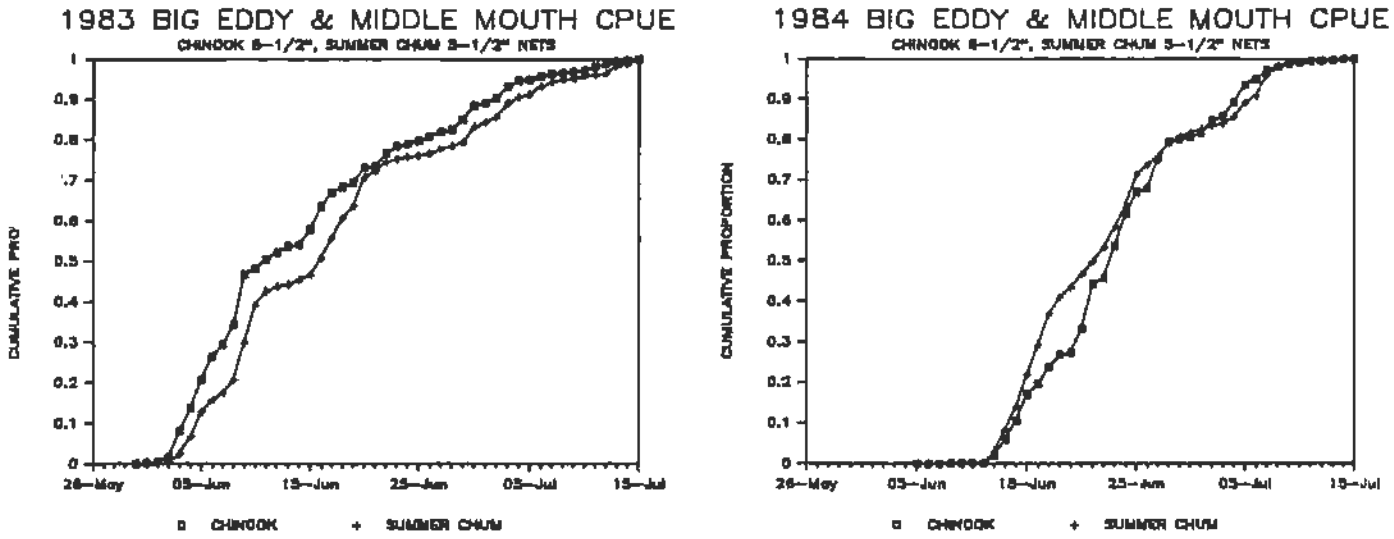
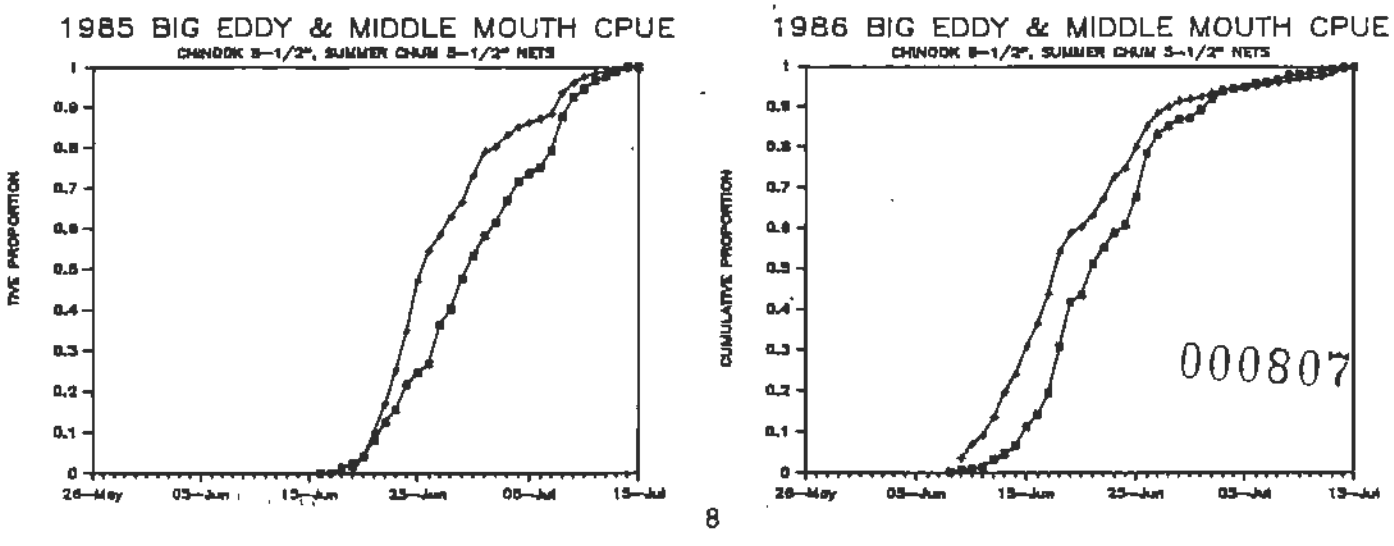
Table 2 The mean date and variance for chinook salmon entering the Yukon River by run of origin. Based on the run proportions of test fishery CPUE from 8.5 inch mesh nets. Day 1 is defined as June 1.

Origin		Year							
		1980	1981	1982	1983	1984	1985	1986	1987
All Stocks	Mean	18.6	15.5	23.3	15.1	23.5	30.5	22.6	24.1
	Variance	75.5	87.4	74.5	115.8	51.8	40.8	43.5	75.1
Lower	Mean			29.8	25.0	25.3	32.0	24.7	
	Variance			53.2	113.1	54.1	38.7	45.4	
Middle	Mean			21.9	13.0	21.1	25.7	22.3	
	Variance			69.8	108.3	40.9	9.8	5.4	
Upper	Mean			20.8	13.5	24.0	29.9	21.6	
	Variance			59.5	75.9	45.8	42.3	40.3	

Figure 4. Cumulative proportions of total chinook and summer chum salmon CPUE by date for the lower Yukon test fishery for 1981-1986.







one or more targeted chinook salmon stocks will likely impact the harvest of other chinook salmon stocks and summer chum salmon.

The fall chum salmon migration in the lower Yukon occurs from mid-July to early September. The coho salmon migration in the lower Yukon occurs in August and early September and overlaps the latter portion of the fall chum run. There is insufficient information on stock compositions of fall chum and coho salmon.

2.2 Management Options

The JTC reviewed a series of general options that could be used to direct fishing effort on one or more chinook salmon stocks. The following introductory remarks apply to these management options:

1) Options listed are possible means of limiting harvest (thereby increasing escapements) in all Yukon drainage fisheries regardless of the type of harvest (commercial or subsistence) or location.

2) Options represent an array of general management tools or strategies which could be employed to increase escapements to spawning grounds or from fisheries and are not intended to constitute an agreed upon plan of action.

3) Options are primarily concerned with management of one or more target chinook salmon stocks (lower, middle, upper river) and their effect on harvest of other stocks or species has not been thoroughly assessed.

4) Several combined options may be required for effective management.

5) Options are not arranged in priority and may not be complete.

6) It is understood that effective stock specific management requires adequate staffing and budget for monitoring harvests, run strengths and escapements in addition to adequate enforcement of fishing regulations.

The various options and their management applicability are presented below in outline form:

1) Fishing Time:

    a. Allow more time between open fishing periods.

* Applied equitably in all major fisheries this strategy would decrease harvest and permit "blocks" of fish to pass on to spawning grounds.

* If not applied river wide, savings made in down-river areas would not necessarily accrue to spawning grounds.

* This strategy would reduce amount of data (catch per unit effort) available for in-season abundance estimation.

* Reductions in total allowable fishing time may not result in proportional reductions in harvests.

b. Decreased length of open fishing periods.

* Applied in all districts/areas this strategy would have the effect of reducing harvests.

* Effect less certain than option A. Reduction in harvest not necessarily proportional to reductions in fishing time. Reductions in fishing time may have to be drastic to be effective.

* May have effect of making catch per unit effort data less comparable with historical data.

2) Delayed season opening.

* In order to protect similar portions of the run, closures in upriver areas would have to be longer than in lower river areas because of variable migration rates, i.e. "pulses" of fish entering lower Yukon "spread out" as fish move up-river.

* Could be an effective strategy if current exploitation rate on late run segment is maintained.

* Possibly less change in the harvests of lower river stocks than options a and b.

3) Specifications and Operation of Gear.

* Examples may include restrictions to gill nets (mesh size, length and depth and hanging ratio) and fishwheel dimensions.

* Implications of changes in mesh size are unclear as to impacts on certain age and sex groups.

* Gear restrictions may not produce proportional savings in catch.

* Advantage - may allow continued incidental harvest of some stocks and/or species and improve quality (sex ratio) of chinook escapements.

4) Reduction of Effort (number of units of gear and/or fishermen).

* Alaska limited entry law includes a buy-back provision.

* In Canada, reduction in effort is possible under current law.

* Decreases in fishing effort may not produce proportional decreases in harvest.

5) Location of Fisheries.

* Closed zones in certain areas may improve escapement.

* Relocation of some fisheries to more terminal areas could allow for exploitation of specific stocks. In addition, the exploitation rate of individual stocks could be adjusted to their productivities, thus maximizing the total harvest.

* Could change traditional harvest allocation patterns and increase cost of monitoring/management of fisheries.

* Could lower quality and value of product in some terminal fisheries.

6) Allocation by district.

* Could alter exploitation of selected stocks/species between districts by manipulating allocations to a particular district or districts.

* Establish maximum harvest levels for each district and area.

3.0 Enhancement

3.1 Introduction

The JTC identified two major approaches to enhancement or the production of more salmon. The first, referred to as natural production, relies primarily on changes in fishery exploitation rates to rebuild natural runs and the restoration of existing spawning habitat to increase fish numbers. The second major approach, supplemental production, involves augmenting natural runs through release of artificially reared fish or the creation of new spawning and/or rearing habitats. This is most often done in the form of hatcheries and spawning channels. Generally, the former approach, natural production method, is regarded as having more certain results, particularly over the long term, causing less management difficultly and being more cost effective. However, only supplemental techniques can be used to increase salmon production above the "natural" level. Also it may be necessary to consider the use of both approaches if the objective is to rebuild Yukon River runs that can sustain harvests above those experienced during recent years.

As one of the initial steps in considering enhancement on the Yukon River, the JTC recommends:

1) reviewing the success of rearing chinook and chum salmon using artificial facilities in other areas around the Pacific rim;
2) determine the freshwater "bottleneck" to the production of chinook and fall chum salmon in the Yukon River (e.g. spawning area, egg to fry survival, obstructions).

3) Evaluate the consequences of specific enhanced production on existing fisheries and users and identify steps that need to be taken to assess impacts on management of mixed wild and enhanced runs. Also consider development of a plan for the entire drainage related to enhancement activities.

3.2 Natural Production

3.2.1 Harvest Strategies

The quickest, safest, and in many situations, the most cost-effective technique for increasing the harvestable surplus of salmon is to rebuild depressed natural stocks. One means of rebuilding depressed stocks involves decreasing exploitation rates using one or more of the harvest strategy options described in section 2.2 of this report. Generally, the period of reduced exploitation would be short-term in nature lasting only as long as necessary to achieve optimal escapement. At the end of the rebuilding period, exploitation rates could be increased to a

sustainable levels. A process similar to that described above may also have an impact on non-target stocks and species.

3.2.2 Habitat Restoration

A second method of increasing natural production includes restoring salmon habitat. Such restoration activities would include, for example, the improvement of existing spawning areas that have suffered as the result of dredging, other industrial activities or lack of use due to natural migratory barriers. In terms of increasing production, habitat restoration may be a longer term prospect than other techniques including changes in harvest strategies. Also, the cost effectiveness of habitat restoration is often uncertain and very site specific.

3.3 Supplemental Production

3.3.1 Short-Term Production

Short-term supplemental production would generally be employed to augment or buffer natural production during a period of rebuilding depressed stocks. As with most forms of supplemental production, it might include building facilities for rearing eggs and juvenile salmon.

3.3.2 Long-Term Production

Long-term or sustained supplemental production is generally used to augment natural production on a permanent basis. This type of production usually requires a major investment in facilities such as hatcheries and personnel. Further, there are uncertainties regarding biological (introduction of disease, availability of brood stock) and management (overharvest of mixed natural runs) considerations associated with this technique.

3.3.3 Habitat Extension

Habitat extension is a potentially attractive technique and would include the removal of velocity barriers or falls to provide access to more spawning area or the construction of spawning channels where the area of natural spawning locations is inadequate. Although a relatively long-term prospect with regard to increasing production, it has much less uncertainty associated with it than long-term supplemental production techniques, as described above. However, as in the case of habitat restoration (see above) the utility and cost of the habitat extension approach is often uncertain and is very site specific.

4.0 Population Estimates from the Canadian Mark-Recapture Program

4.1 Introduction

Canada has operated a mark-recovery program on the Yukon River at the Canada/US border each year since 1982 excluding 1984. Spaghetti tags are applied to salmon live-captured in the test fishwheels and subsequent recoveries are made in the lower Canadian commercial fishery. The objective of the program is to provide the data necessary to estimate the total number of chinook and fall chum salmon moving from the U.S. portion of the Yukon River watershed to the Canadian portion of the watershed. From such estimates it is possible to determine spawning escapements and harvest rates.

4.2 U.S. Review of Program

In a previous meeting of the JTC, the U.S. provided a written review of the mark-recovery program. The review indicated that in order for the Petersen type of population estimate to be accurate, the following assumptions must be validated:

1) The population is closed (no mortality occurs between capture and recapture).
2) All fish have equal probability of being captured for marking.
3) The second sample (recapture) is a simple random sample, i.e. all individuals have an equal change for recapture.
4) Marking does not affect the catchability of a fish (i.e. no post-tagging mortality or handling mortality).
5) All recaptures are reported.
6) Fish retain their marks between release and recapture (i.e. no tag loss occurs).

Specific recommendations contained in the U.S. review were as follows:

1) Mark and recapture data should be stratified by sex, by size, by recapture gear and through time. Goodness-of-fit tests for consistency should be conducted and results reported annually. Tag and release data should be made available for peer review.

2) The choice of a method to estimate population size (pooled or stratified Petersen) should be based on the results of the goodness-of-fit tests. A pooled Petersen estimate should not be published if significantly different recovery rates between sexes, major size categories, gear, or through time are found to exist. Population estimates should not be published without an estimated variance.

3) Further investigation is needed to resolve the problem of the skewed sex ratio of the estimated fall chum salmon populations in 1982 and 1983. Data should be stratified by

recapture gear. Larger samples of age, sex, and length data need to be collected from harvests and escapements.

4) Estimates of mark (tag) loss, non-reporting of marked fish recoveries and downstream movement of marked fish need to be systematically documented. Suggest that application of double marks and increased monitoring of catches made upstream and downstream of tagging sites be implemented.

4.3. Canadian Comments on U.S. Review

Canada believes the comments in the U.S. review are constructive, agrees with the general thrust of the U.S. recommendations and will endeavor to follow through on each one of them.

Assumption 1: Closed Population

It is agreed that subject to difficulties with assumption number four (see below) there is no violation of assumption number one.

Assumptions 2 and 3: Capture and Recapture is unaffected by Selective Methods

It is agreed that violations of assumptions two and three which require that all chinook and fall chum salmon have an equal chance of being captured for marking and of being recaptured in the commercial fleet is of greatest concern. It is agreed that goodness-of-fit tests should be conducted to detect potential significant differences in recovery rates of tagged salmon among different sizes classes and between sexes. Further, when such differences exist, the Petersen method should not be used. To partially address these concerns it is suggested that:

1) Experimental, variable mesh gill nets be fished across the breadth of the River at the tagging site to determine if there are size and/or sex differences in the fish using different parts of the cross-section of the River.

2) An attempt be made to record the specific characteristics of the fishing gear used to capture fish in the commercial fishery (i.e. fishwheel, gill net, gill net mesh size, etc.).

Assumptions 2 and 3: The Probability of Capture and Recapture Through Time is Constant.

There is agreement with the U.S. comments, particularly as they apply to the use of the Schaefer method.

Assumption 4: Marking Doe Not Affect the Catchability of Salmon

Two tagged chinook salmon captured at Eagle in 1983 are evidence of a common feature of tagging in rivers where fish will "drop back" some distance presumably in response to the stress of handling and tagging. It is recommended that a study be designed to determine the rate of occurrence of this phenomenon for chinook and fall chum salmon at the tagging site and that any tag loss estimate be incorporated into the precision of the population estimates.

Assumptions 5 and 6: Salmon Do Not Lose Their Marks and All Recovered Marked Fish Are Reported

Double tagging both chinook and fall chum salmon should occur annually to determine the potential magnitude of the tag loss problem.

Although conducting a recapture program with trained employees only would be the ideal way to remove any concerns about the under-reporting of recaptured tagged fish, it is probably not possible due to resource limitations. This is probably not an important issue at this time. Currently a patrolman is at the site of the commercial fishery on most days the fishery is open. In addition, there is a monetary reward for tags returned, and radio broadcasts and notices in local newspapers dealing with the importance of returning tags.

In addition to the above comments, Canada also intends to:

1) Identify over the next several months which assumptions will be evaluated as part of the 1988 mark-recovery program.

2) Prepare a written report documenting the operation of and the analyses leading to population estimates from the 1987 program by March 1989. Reports for subsequent programs will be available within 18 months following the field component of the study. Re-evaluation and documentation of the 1982, 1983, 1985, and 1986 mark-recovery programs will be completed as time permits.

5.0 Data Exchanges

Canada responded to requests for special data made at the October 1987 JTC meeting by providing the following:

1) copies of fisheries public notices issued from 1983 to 1987;

2) numbers of commercial and domestic fishing licenses issued (and numbers with landings) from 1980-1987;

3) production of commercially caught chinook and fall chum salmon by Han Fisheries Plant (fresh-frozen) and by individual fishermen (fresh, dried, smoked);

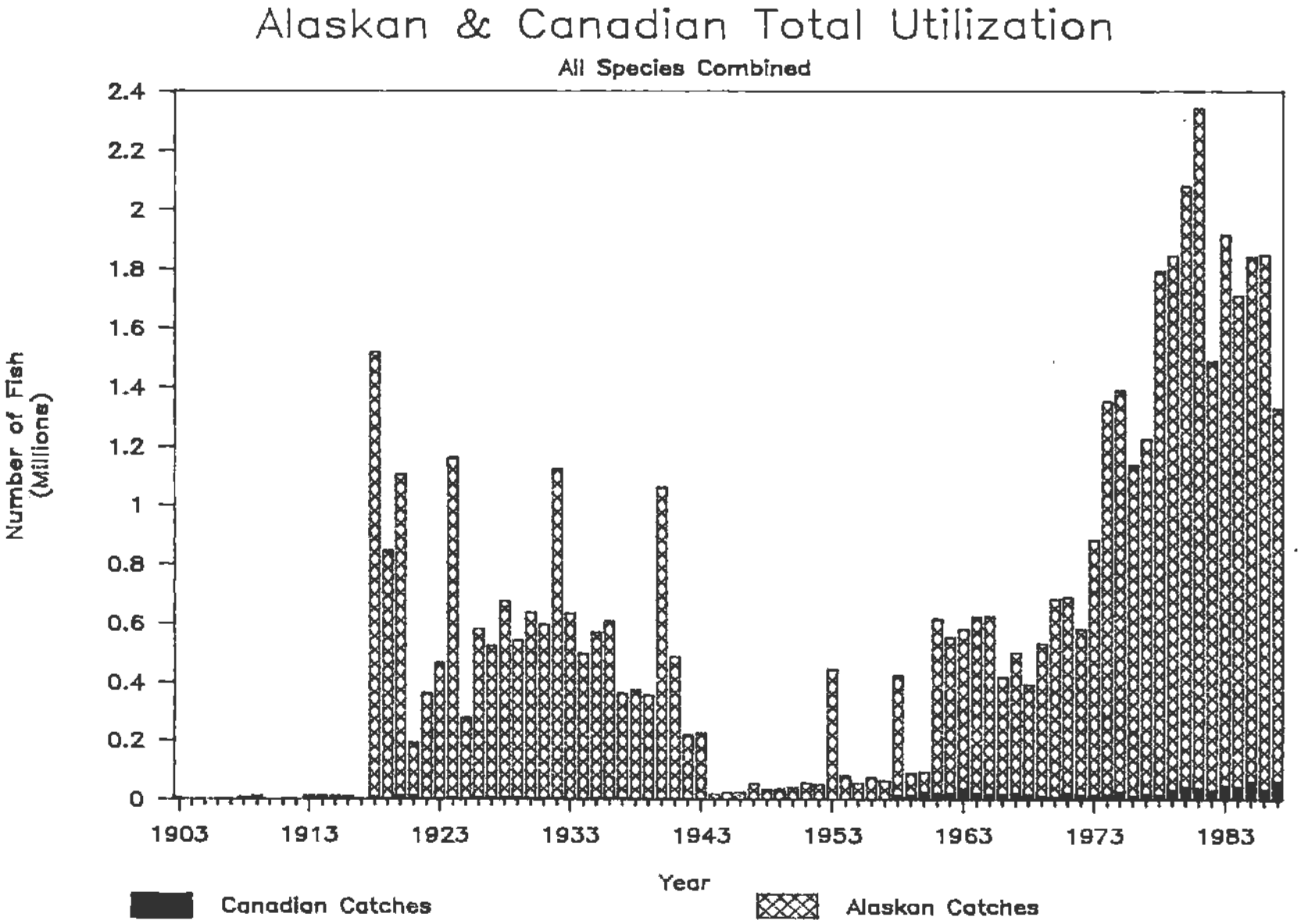
4) number of Indian food fishery licenses issued from 1974 to 1985;

5) organizational chart of Department of Fisheries.

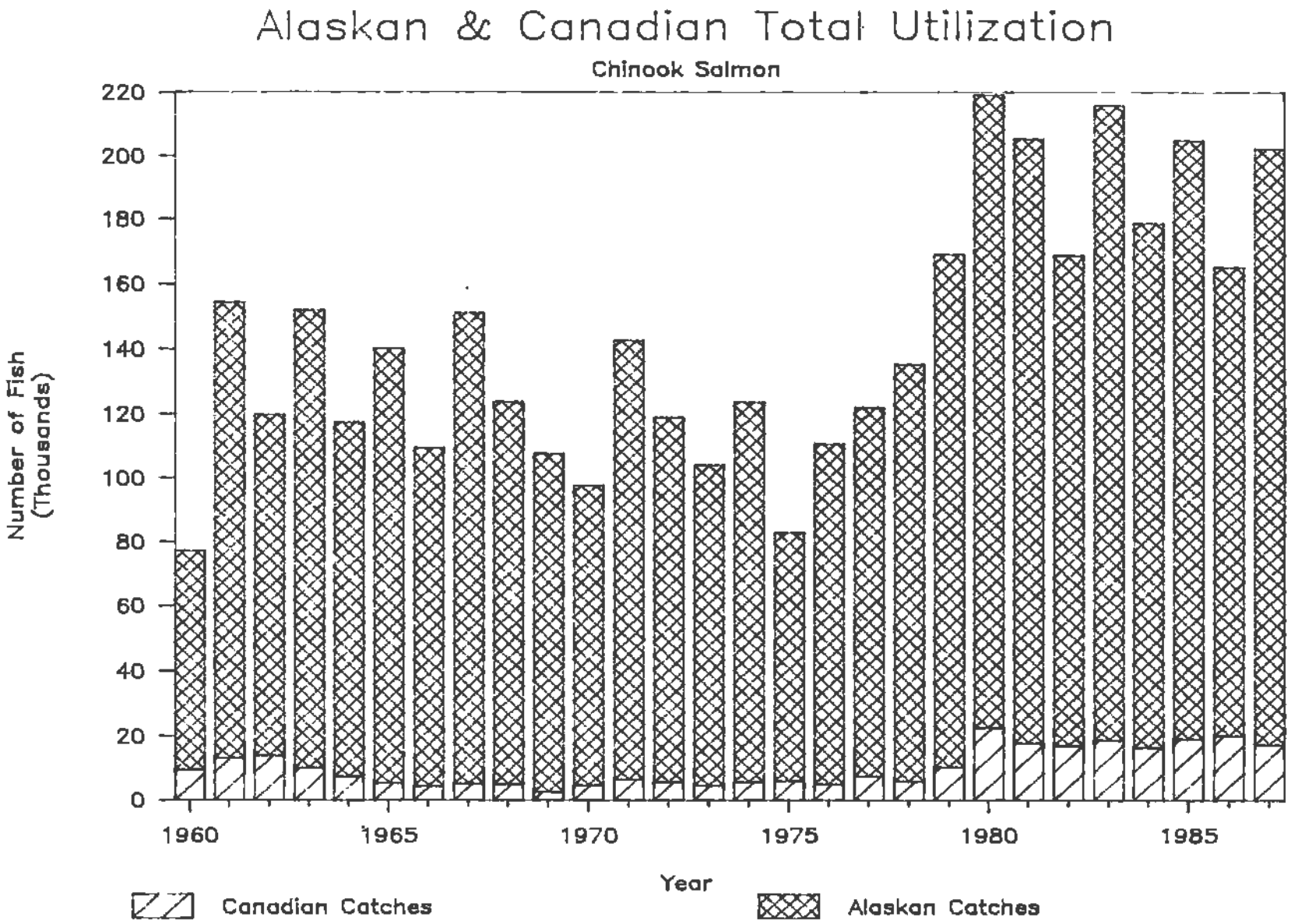
U.S. responded to the single data request by providing organizational charts of the Alaska Department of Fish and Game (Division of Commercial Fisheries), U.S. Fish and Wildlife Service and National Marine Fisheries Service.

6.0 Appendix

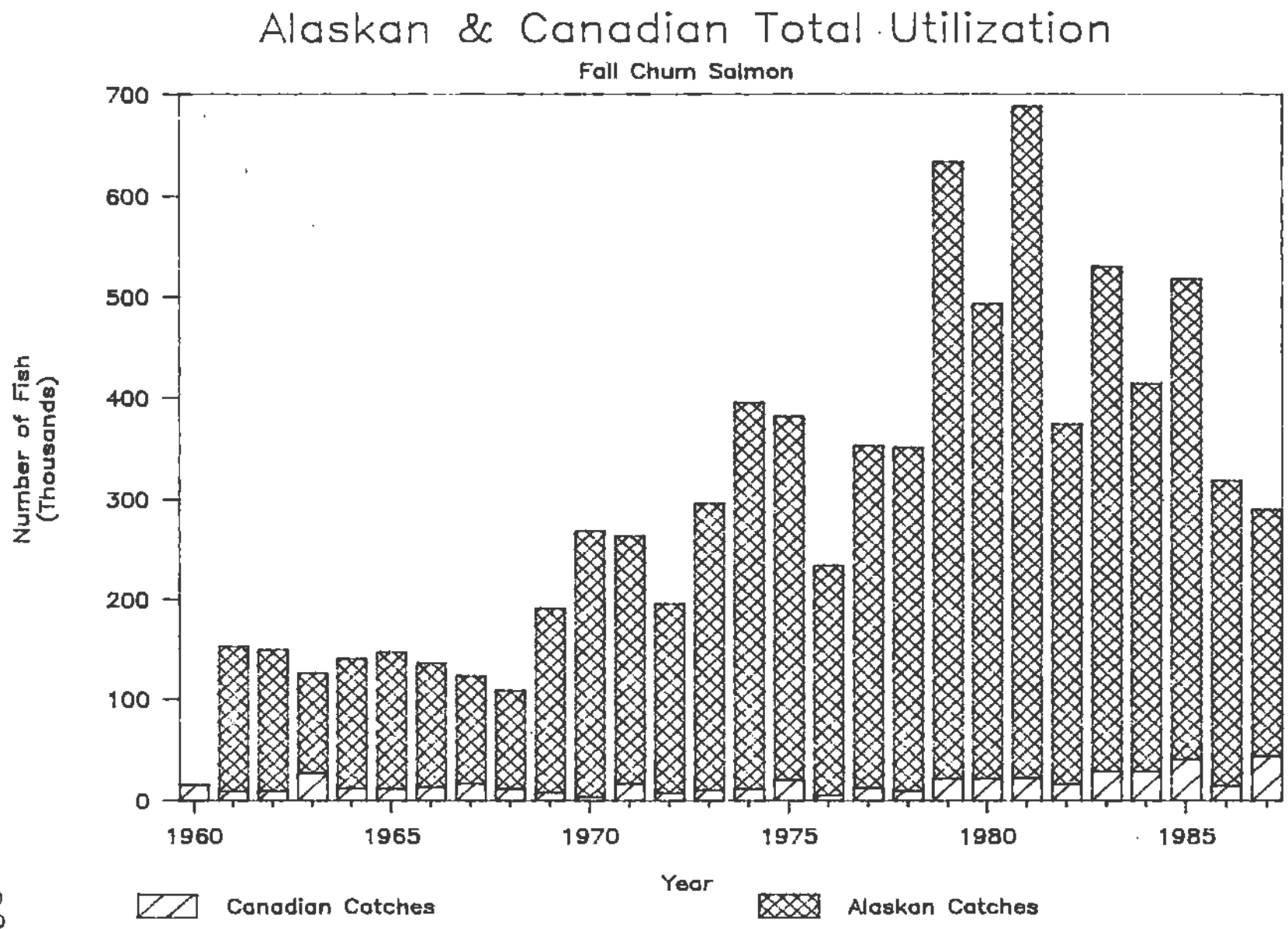
Appendix Figure 1.



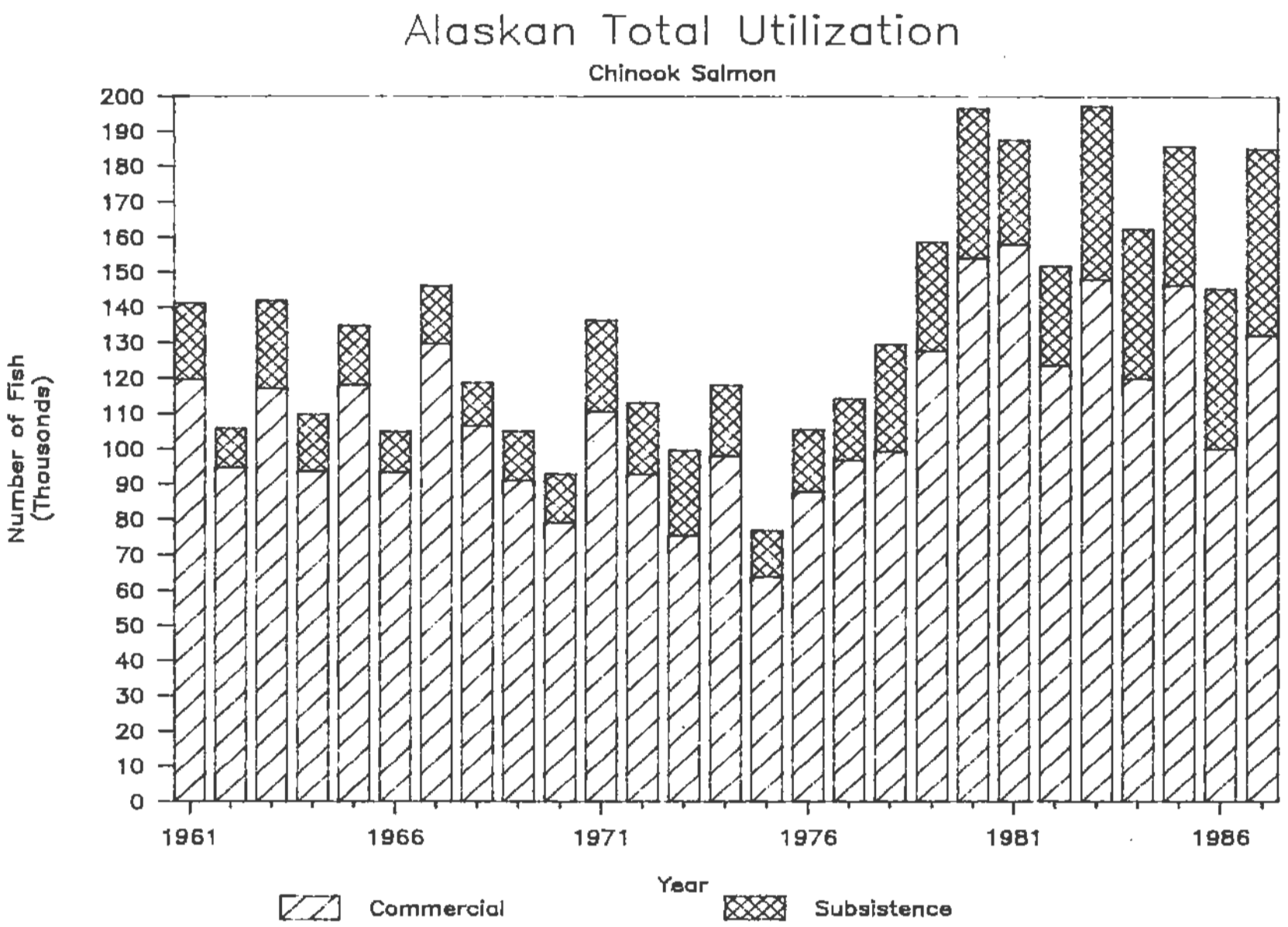
Appendix Figure 2.



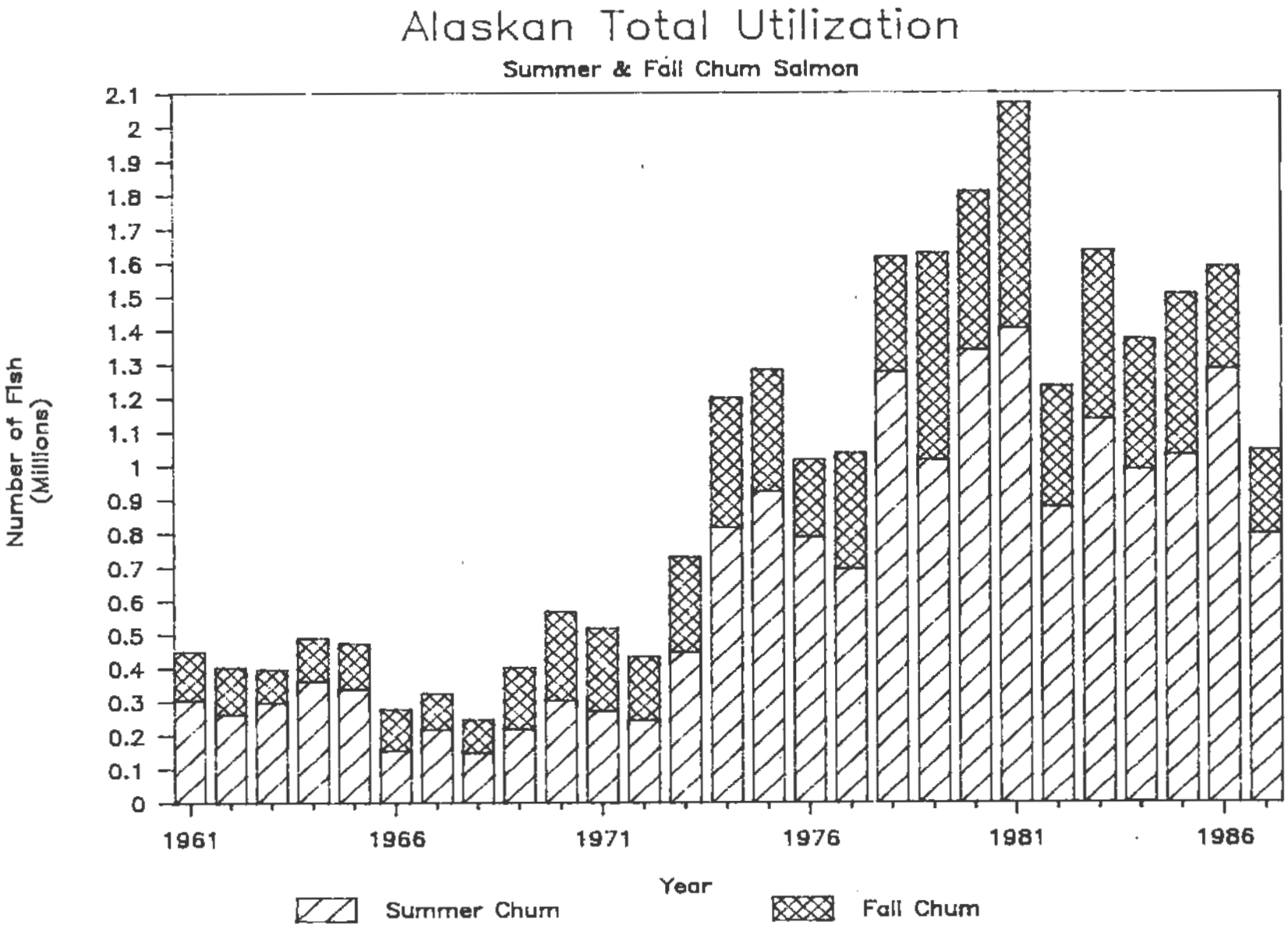
Appendix Figure 3.



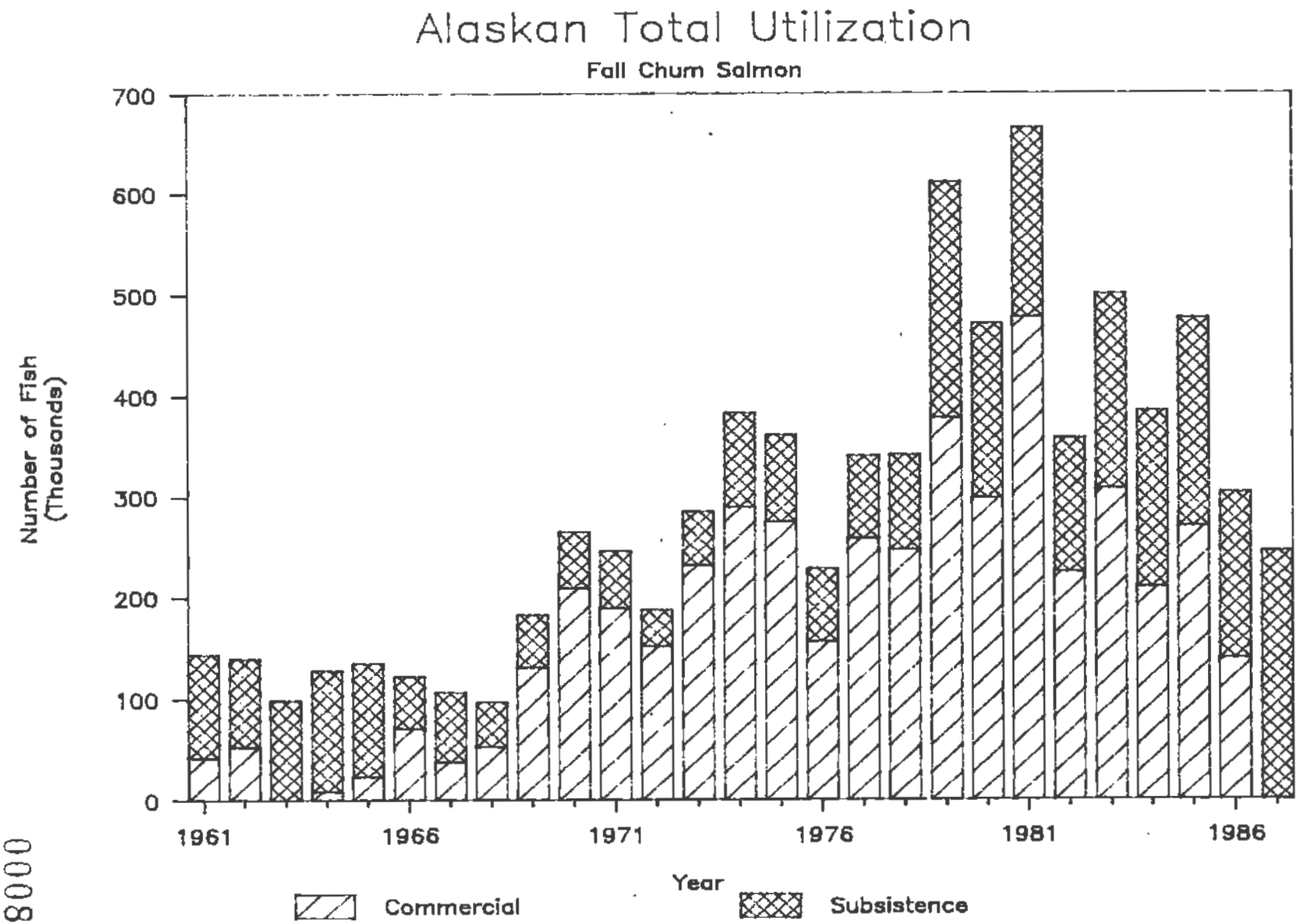
Appendix Figure 4.



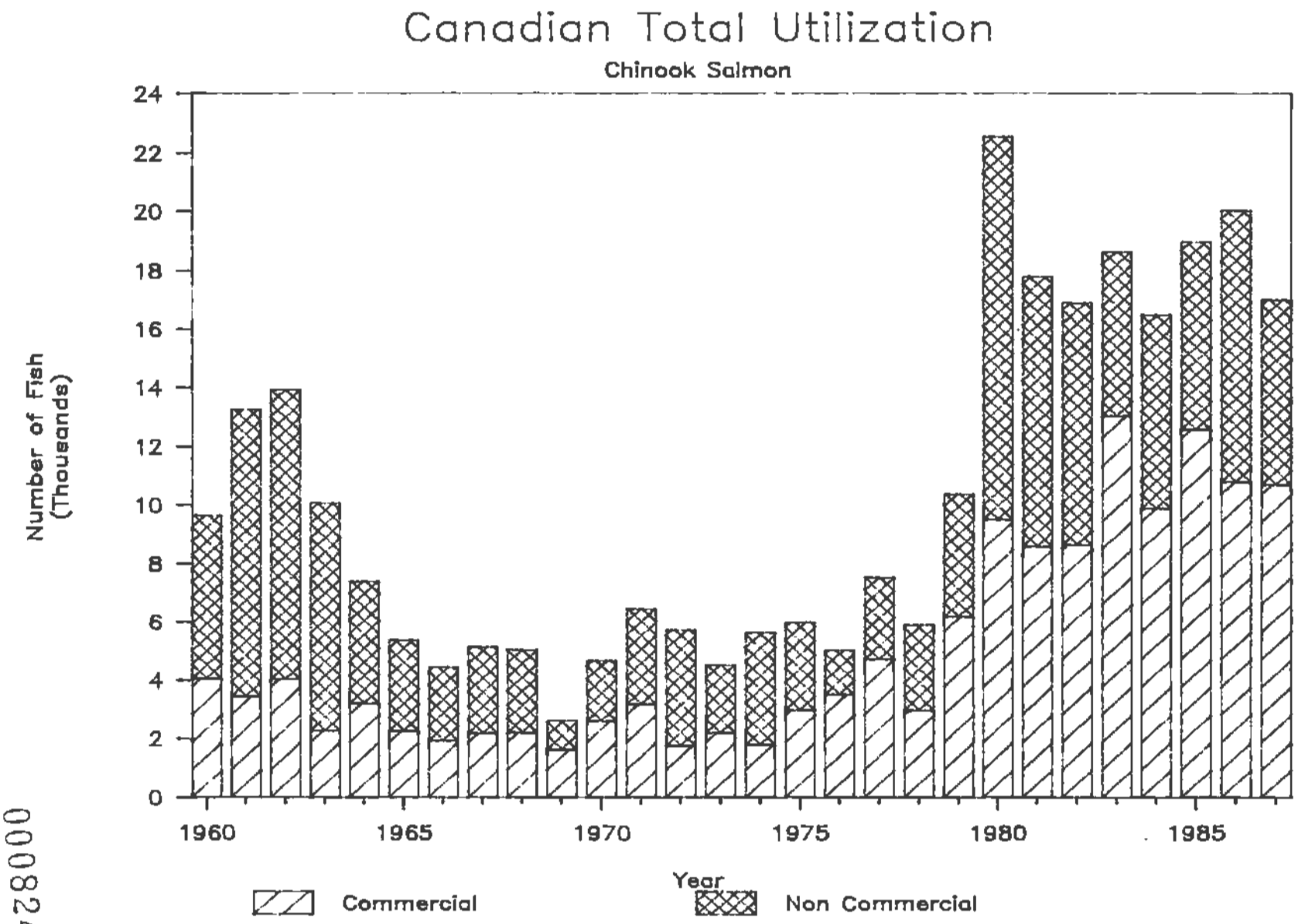
Appendix Figure 5.



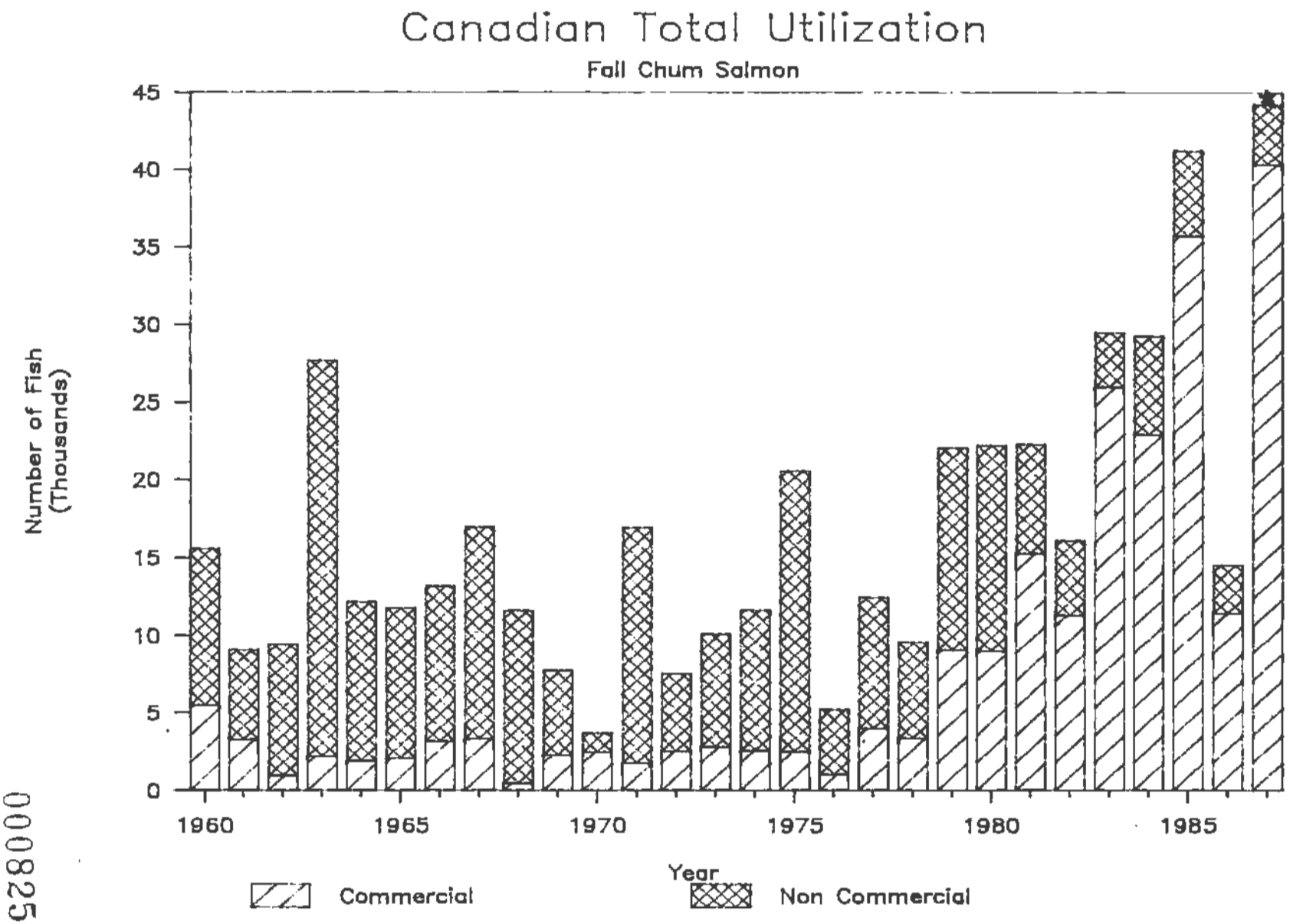
Appendix Figure 6.



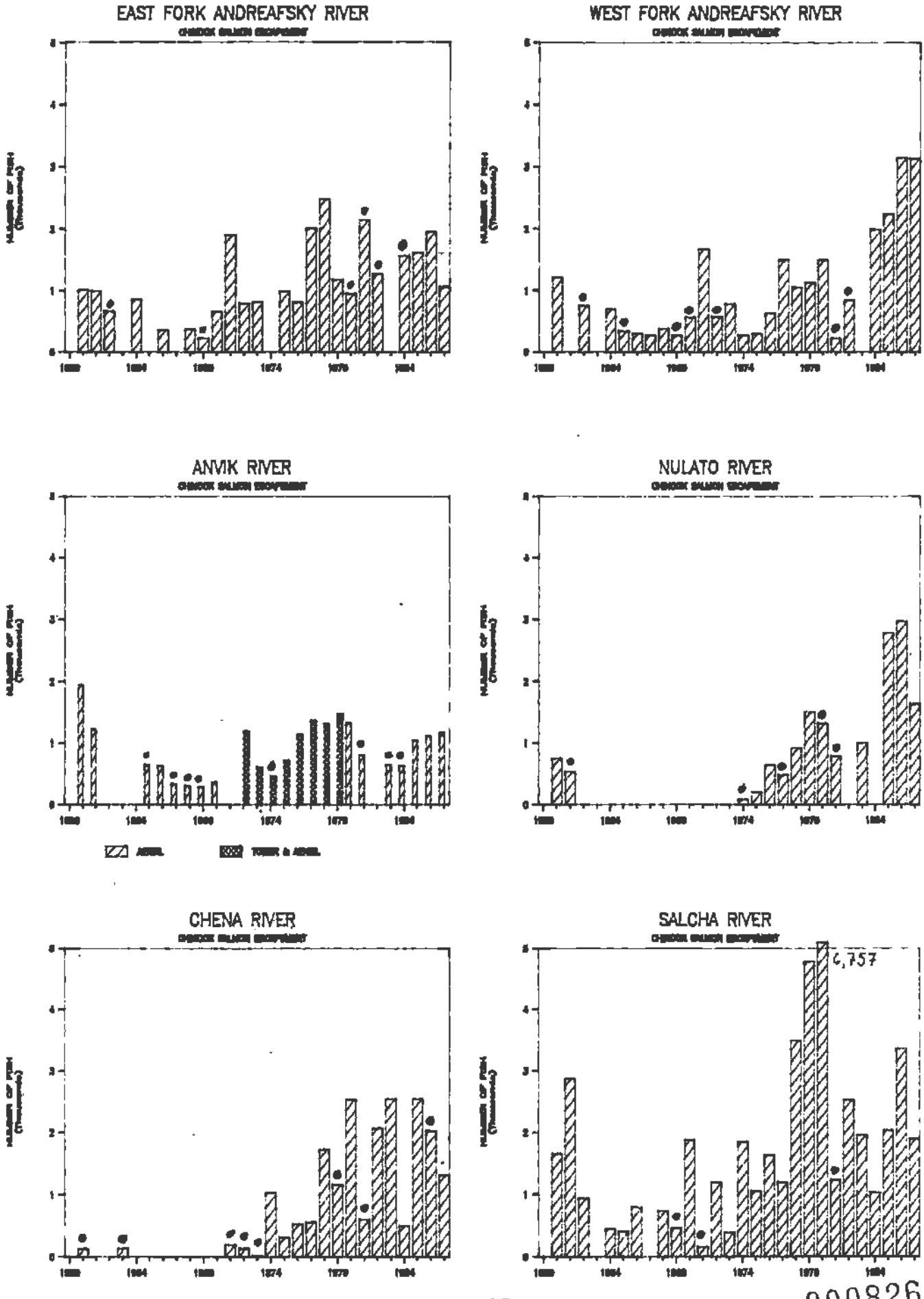
Appendix Figure 7.



Appendix Figure 8. Asterisk indicates preliminary data. Old Crow harvest not available.



Appendix Figure 9.



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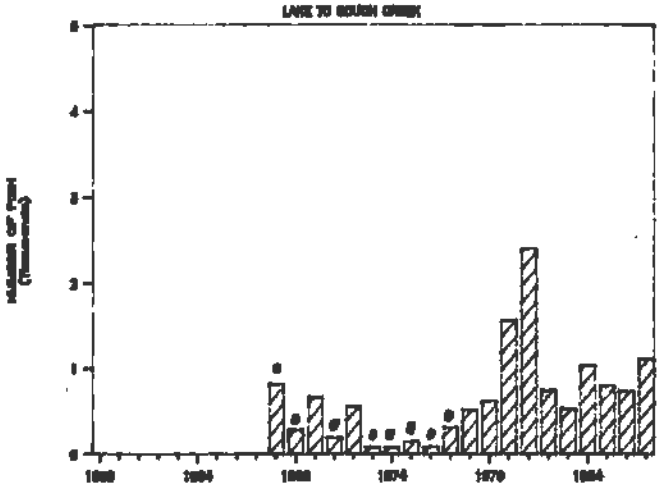
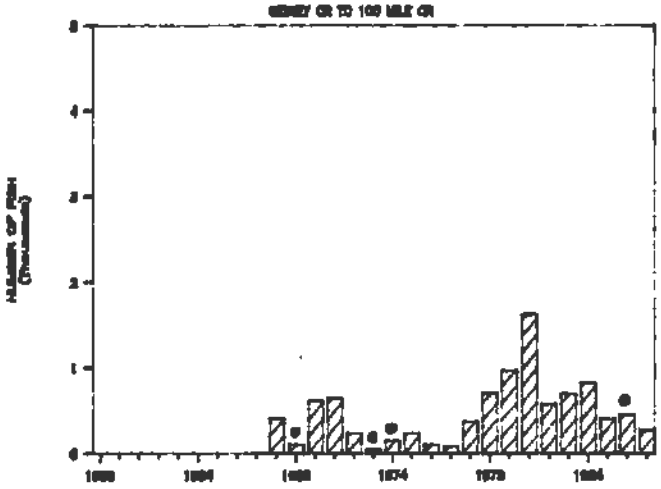
Appendix Figure 9. (Continued).

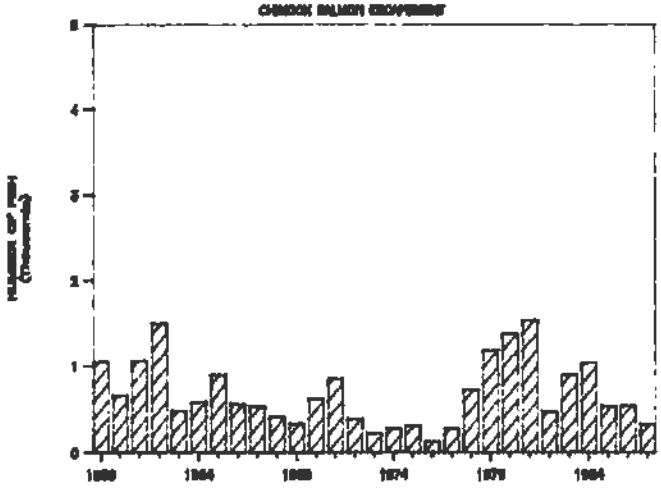
BIG SALMON RIVER CHINOOK



NISUTLIN RIVER CHINOOK



WHITEHORSE DAM FISHWAY



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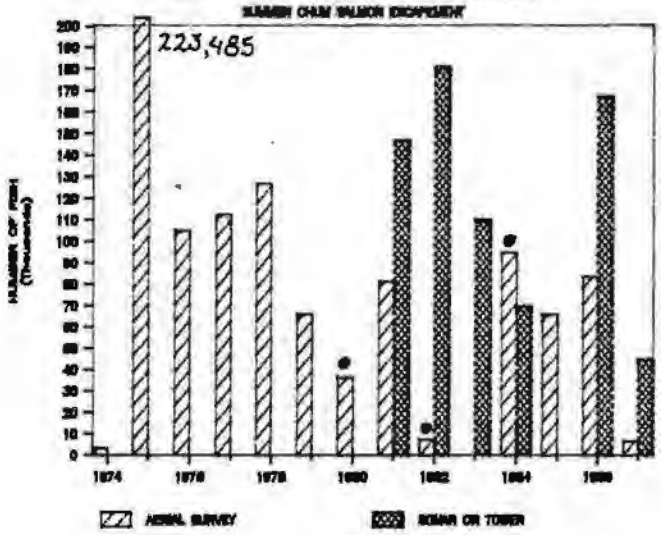
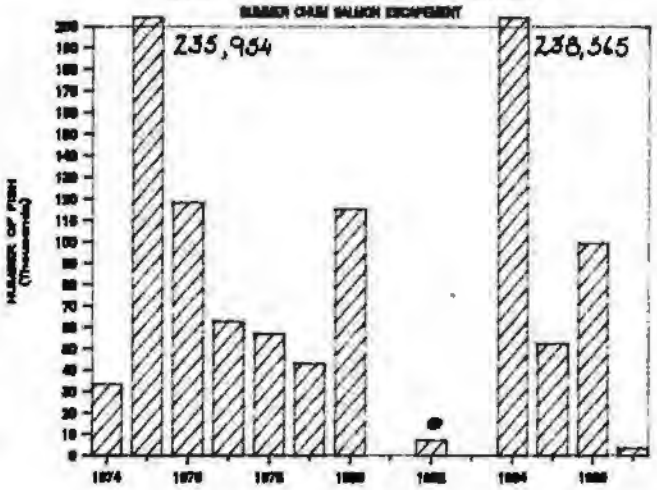
Appendix Figure 10.

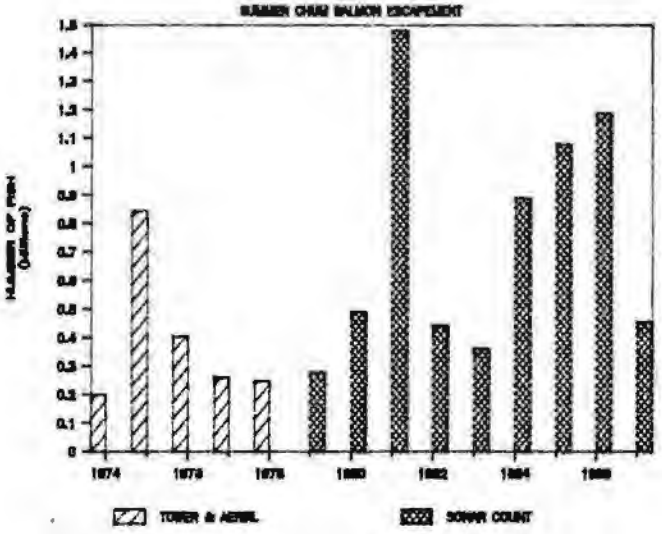
EAST FORK ANDREAFSKY RIVER



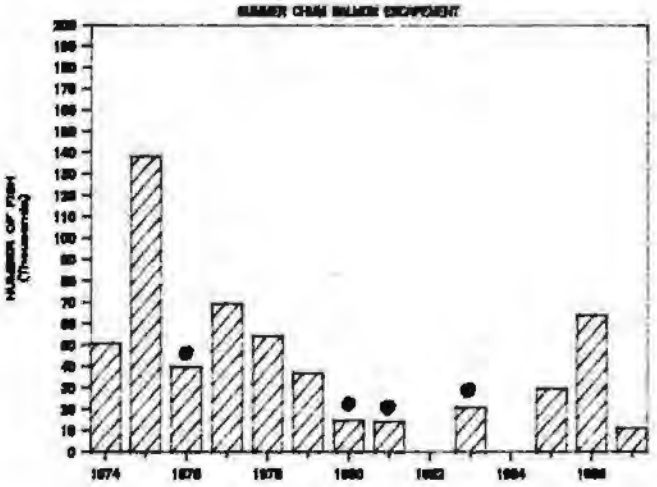
WEST FORK ANDREAFSKY RIVER



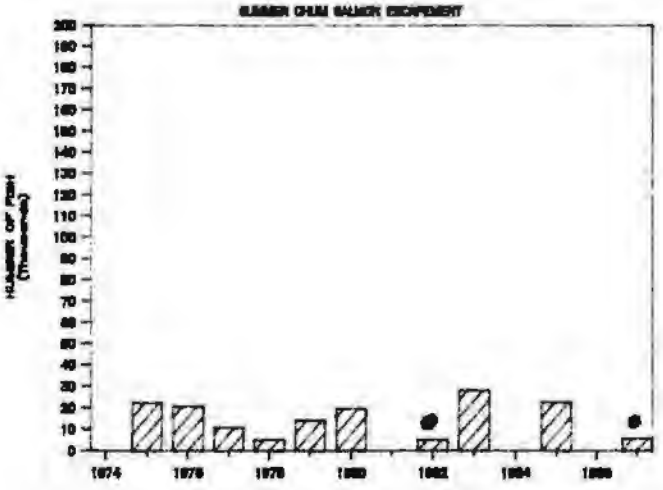
ANVIK RIVER



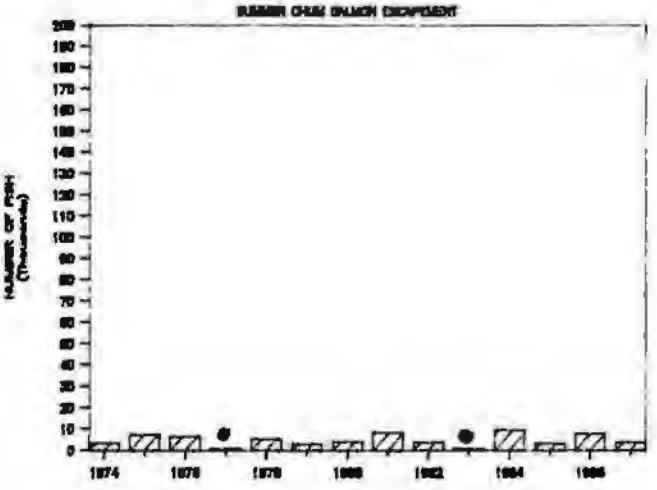
NULATO RIVER



HOGATZA RIVER



SALCHA RIVER



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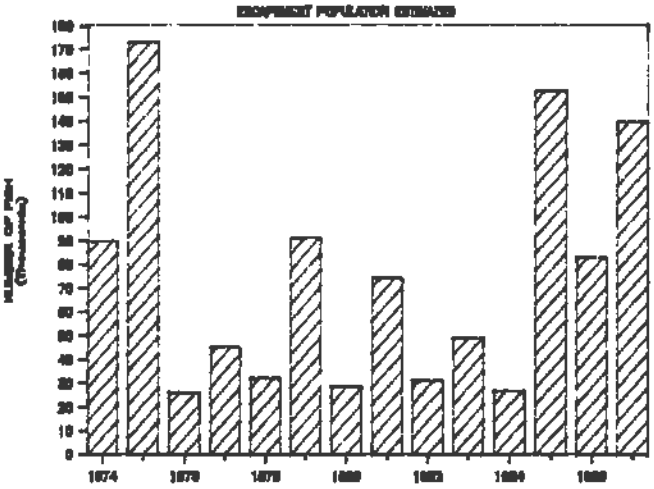
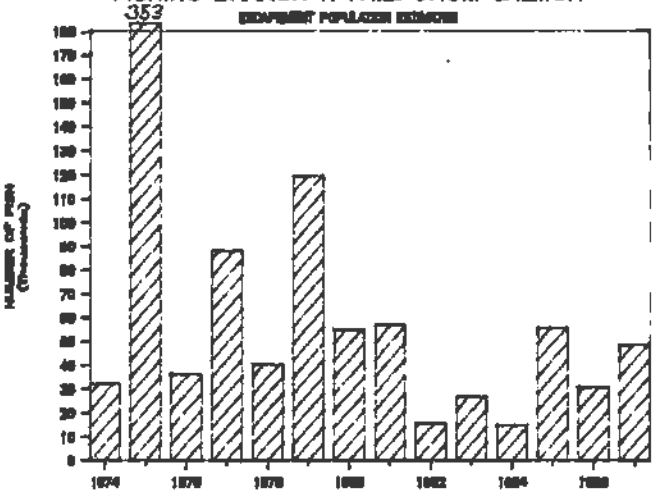
Appendix Figure 11.

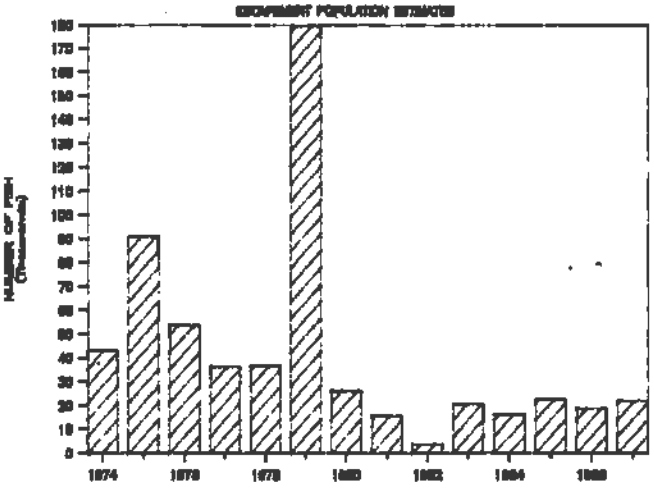
SHEENJEK RIVER FALL CHUM SALMON



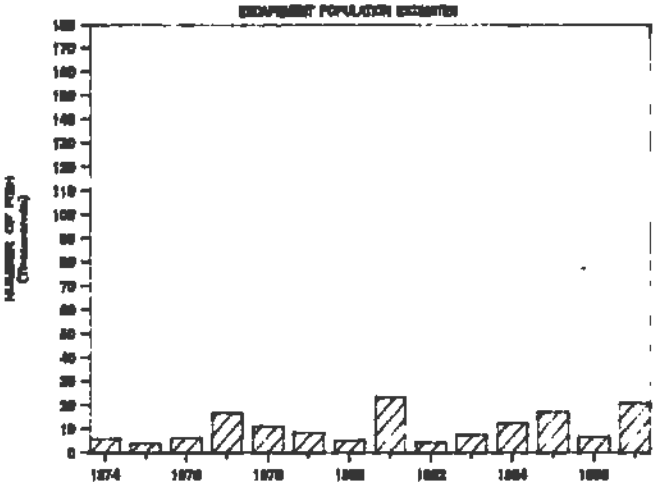
FISHING BRANCH R FALL CHUM SALMON



UPPER TOKLAT R FALL CHUM SALMON



DELTA RIVER FALL CHUM SALMON



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Appendix Table 1. Alaskan and Canadian total utilization of Yukon River salmon, 1903-1987. a

Year	Alaska			Canada			Total		
	Chinook	Other Salmon	Total	Chinook	Other Salmon	Total	Chinook	Other Salmon	Total
1903						4,666			4,666
1904									
1905									
1906									
1907									
1908						7,000			7,000
1909						9,228			9,228
1910									
1911									
1912									
1913						12,133			12,133
1914						12,573			12,573
1915						10,466			10,466
1916						9,366			9,366
1917									
1918	12,239	1,500,065	1,512,304			7,066	12,239	1,500,065	1,519,370
1919	104,822	738,790	843,612			1,800	104,822	738,790	845,412
1920	78,467	1,015,655	1,094,122			12,000	78,467	1,015,655	1,106,122
1921	69,646	112,098	181,744			10,840	69,646	112,098	192,584
1922	31,825	330,000	361,825			2,420	31,825	330,000	364,245
1923	30,893	435,000	465,893			1,833	30,893	435,000	467,725
1924	27,375	1,130,000	1,157,375			4,360	27,375	1,130,000	1,161,335
1925	15,000	259,000	274,000			1,900	15,000	259,000	277,900
1926	20,500	555,000	575,500			4,373	20,500	555,000	579,873
1927		520,000	520,000			5,366		520,000	525,366
1928		670,000	670,000			5,733		670,000	675,733
1929		537,000	537,000			5,225		537,000	542,225
1930		633,000	633,000			3,660		633,000	636,660
1931	26,693	565,000	591,693			2,473	26,693	565,000	595,166
1932	27,899	1,092,000	1,119,899			4,200	27,899	1,092,000	1,124,099
1933	28,779	603,000	631,779			2,333	28,779	603,000	633,112
1934	23,363	474,000	497,363			2,000	23,363	474,000	499,363
1935	27,665	557,000	584,665			3,466	27,665	557,000	588,131
1936	43,713	560,000	603,713			3,400	43,713	560,000	607,113
1937	12,154	346,000	358,154			3,746	12,154	346,000	161,900
1938	32,971	340,450	373,421			860	32,971	340,450	374,281
1939	28,037	327,650	355,687			720	28,037	327,650	356,407
1940	32,453	1,029,000	1,061,453			1,153	32,453	1,029,000	1,062,606
1941	47,608	438,000	485,608			2,806	47,608	438,000	488,414
1942	22,487	197,000	219,487			713	22,487	197,000	220,200
1943	27,650	200,000	227,650			589	27,650	200,000	228,239
1944	14,232		14,232			986	14,232		15,218
1945	19,727		19,727			1,333	19,727		21,060
1946	22,782		22,782			353	22,782		23,135
1947	54,026		54,026			120	54,026		54,146
1948	33,842		33,842				33,842		33,842
1949	35,379		35,379				35,379		35,379
1950	41,000		41,808				41,808		41,808
1951	56,278		56,278				56,278		56,278
1952	38,637	10,868	49,505				38,637	10,868	49,505
1953	58,859	385,977	444,836				58,859	385,977	444,836
1954	64,543	14,375	78,920				64,543	14,375	78,920
1955	55,925		55,925				55,925		55,925
1956	62,208	10,743	72,951				62,208	10,743	72,951
1957	53,623		53,623				53,623		53,623
1958	75,625	237,500	413,125	11,000	1,500	12,500	86,625	339,000	425,625
1959	78,370		78,370	8,434	1,098	11,532	86,804	3,098	89,902
1960	67,597		67,597	9,653	15,608	25,261	77,250	15,608	92,858
1961	141,152	452,521	593,673	13,246	9,075	22,322	154,398	461,597	615,995
1962	105,844	425,277	531,121	13,937	9,436	23,373	119,781	434,713	554,494
1963	141,910	401,700	543,610	10,077	27,696	37,773	151,987	429,396	581,383
1964	109,618	492,233	602,051	7,408	12,187	19,595	117,226	504,420	621,646
1965	134,706	472,798	607,504	5,180	11,789	17,169	140,086	484,587	624,673
1966	104,687	296,310	401,197	4,452	13,192	17,644	109,139	309,502	418,841
1967	146,104	335,436	481,540	5,150	16,961	22,111	151,254	352,397	503,651
1968	118,632	259,185	377,817	5,042	11,633	16,675	123,674	270,818	394,492
1969	105,027	416,623	521,650	2,624	7,776	10,400	107,651	424,399	532,050
1970	93,019	582,049	675,068	4,653	3,711	8,374	97,682	585,760	683,442
1971	136,191	530,537	666,728	6,447	16,911	23,358	142,638	547,448	690,086
1972	113,098	454,085	567,183	5,729	7,532	13,261	118,827	461,617	580,444
1973	99,670	769,023	868,693	4,522	10,135	14,657	104,192	779,158	883,350
1974	118,053	1,218,032	1,336,085	5,631	11,646	17,277	123,684	1,229,678	1,353,362
1975	76,863	1,286,437	1,363,320	6,000	20,600	26,600	82,863	1,307,037	1,389,920
1976	105,582	1,021,706	1,127,290	5,025	5,200	10,225	110,607	1,026,908	1,137,515
1977	114,338	1,090,330	1,204,668	7,527	12,479	20,006	121,865	1,102,809	1,224,674
1978	123,465	1,650,942	1,780,407	5,881	9,366	15,447	129,346	1,660,308	1,795,854
1979	158,578	1,654,445	1,813,123	10,375	22,084	32,459	169,053	1,676,529	1,845,582
1980	195,709	1,840,123	2,036,832	22,546	22,218	44,764	218,255	1,862,341	2,081,596
1981	187,708	2,115,459	2,303,167	17,809	22,281	40,090	205,517	2,137,740	2,343,257
1982	151,802	1,306,171	1,457,973	16,908	15,091	32,999	168,710	1,322,262	1,490,972
1983	157,288	1,673,071	1,830,459	18,652	29,490	48,142	215,040	1,702,561	1,919,601
1984	162,222	1,502,911	1,665,143	15,495	29,267	45,762	178,727	1,532,178	1,710,905
1985	185,559	1,597,127	1,783,086	19,001	44,515	50,516	204,960	1,638,542	1,843,502
1986	145,653	1,669,326	1,815,078	20,054	14,826	34,900	165,215	1,684,662	1,849,378
1987 b	185,095	1,044,225	1,229,320	17,220	44,245	61,575	202,425	1,128,480	1,330,905

a Commercial and subsistence harvest examined in numbers of fish, including "equivalent fish" converted from roe sales. See ADF&G 1985 Yukon Area Annual Management Report for data sources and methods of catch estimation used for some years.

b Preliminary.

endix Table 2. Alaskan and Canadian total utilization of Yukon River chinook and fall chum salmon, 1960-1987. a

	Chinook			Fall Chum		
Year	Canada b	Alaska c	Total	Canada b	Alaska c	Total
1960	9,653	67,597 d	77,250	15,608	-- e	15,608
1961	13,246	141,152	154,398	9,076	144,233	153,309
1962	13,937	105,844	119,781	9,436	140,401	149,837
1963	10,077	141,910	151,987	27,696	99,031 f	126,727
1964	7,408	109,818	117,226	12,187	128,707	140,894
1965	5,380	134,706	140,086	11,789	135,600	147,389
1966	4,452	104,887	109,339	13,192	122,548	135,740
1967	5,150	146,104	151,254	16,961	107,018	123,979
1968	5,042	118,632	123,674	11,633	97,552	109,185
1969	2,624	105,027	107,651	7,776	183,373	191,149
1970	4,663	93,019	97,682	3,711	265,096	268,807
1971	6,447	136,191	142,638	16,911	246,756	263,667
1972	5,729	113,098	118,827	7,532	188,178	195,710
1973	4,522	99,670	104,192	10,135	285,760	295,895
1974	5,631	118,053	123,684	11,646	383,552	395,198
1975	6,000	76,883	82,883	20,600	361,600	382,200
1976	5,025	105,582	110,607	5,200	228,717	233,917
1977	7,527	114,338	121,865	12,479	340,757	353,236
1978	5,881	129,465	135,346	9,566	341,878	351,444
1979	10,375	158,678	169,053	22,084	611,759	633,843
1980	22,546	196,709	219,255	22,218	471,107	493,325
1981	17,809	187,708	205,517	22,281	666,261	688,542
1982	16,908	151,802	168,710	16,091	357,889	373,980
1983	18,652	197,388	216,040	29,490	500,592	530,082
1984	16,495	162,332	178,827	29,267	385,383	414,650
1985	19,001	185,959	204,960	41,265	476,741	518,006
1986	20,064	145,252	165,316	14,536	304,053	318,589
1987 g	17,330	185,095	202,425	44,245	245,834 f	290,079
Average						
1962-66	8,251	119,433	127,684	14,860	125,257	140,117
1967-71	4,785	119,795	124,580	11,398	179,959	191,357
1972-76	5,381	102,657	108,039	11,023	289,561	300,584
1977-81	12,828	157,380	170,207	17,726	486,352	504,078
1982-86	18,224	168,547	186,771	26,130	404,932	431,061

a Catch in numbers of fish, including "equivalent fish" converted from roe sales.
b Commercial, Indian Food, and Domestic catches combined.
c Commercial and Subsistence catches combined.
d Commercial catches only; subsistence catches not documented.
ubsistence catch not documented; commercial fishery did not operate.
ubsistence catch only; commercial fishery did not operate.
g Preliminary; does not include Old Crow harvest.

000831

Appendix Table 3. Alaskan catch of Yukon River chinook salmon, 1961-1987. a

Year	Subsistence	Commercial	Total
1961	21,488	119,664	141,152
1962	11,110	94,734	105,844
1963	24,862	117,048	141,910
1964	16,231	93,587	109,818
1965	16,608	118,098	134,706
1966	11,572	93,315	104,887
1967	16,448	129,656	146,104
1968	12,106	106,526	118,632
1969	14,000	91,027	105,027
1970	13,874	79,145	93,019
1971	25,684	110,507	136,191
1972	20,258	92,840	113,098
1973	24,317	75,353	99,670
1974	19,964	98,089	118,053
1975	13,045	63,838	76,883
1976	17,806	87,776	105,582
1977	17,581	96,757	114,338
1978	30,297	99,168	129,465
1979	31,005	127,673	158,678
1980	42,724	153,985	196,709
1981	29,690	158,018	187,708
1982	28,158	123,644	151,802
1983	49,478	147,910	197,388
1984	42,428	119,904	162,332
1985	39,771	146,188	185,959
1986	45,282	99,970	145,252
1987	53,124	131,971	185,095
Average			
1962-66	16,077	103,356	119,433
1967-71	16,422	103,372	119,795
1972-76	19,078	83,579	102,657
1977-81	30,259	127,120	157,380
1982-86	41,023	127,523	168,547

a Catch in numbers of fish.

Appendix Table 4. Canadian catch of Yukon River chinook salmon (including Porcupine River), 1960-1987. a

Year	Commercial	Non Commercial			Total
		Domestic	Indian Food Fish	Combined	
1960	4,058		5,595	5,595	9,653
1961	3,446		9,800	9,800	13,246
1962	4,037		9,900	9,900	13,937
1963	2,283		7,794	7,794	10,077
1964	3,208		4,200	4,200	7,408
1965	2,265		3,115	3,115	5,380
1966	1,942		2,510	2,510	4,452
1967	2,187		2,963	2,963	5,150
1968	2,212		2,830	2,830	5,042
1969	1,640		984	984	2,624
1970	2,611		2,052	2,052	4,663
1971	3,178		3,269	3,269	6,447
1972	1,769		3,960	3,960	5,729
1973	2,199		2,323	2,323	4,522
1974	1,808	406	3,417	3,823	5,631
1975	3,000	400	2,600	3,000	6,000
1976	3,500	500	1,025	1,525	5,025
1977	4,720	531	2,276	2,807	7,527
1978	2,975	421	2,485	2,906	5,881
1979	6,175	1,200	3,000	4,200	10,375
1980	9,500	3,500	9,546	13,046	22,546
1981	8,593	237	8,979	9,216	17,809
1982	8,640	435	7,833	8,268	16,908
1983	13,027	400	5,225	5,625	18,652
1984	9,885	260	6,350	6,610	16,495
1985	12,573	478	5,950	6,428	19,001
1986	10,797	342	8,925	9,267	20,064
1987 b	10,704	330	5,996	6,326	17,330
Average					
1962-66	2,747	--	5,504	5,504	8,251
1967-71	2,366	--	2,420	2,420	4,785
1972-76	2,455	435	2,665	2,926	5,381
1977-81	6,393	1,178	5,257	6,435	12,828
1982-86	10,984	383	6,857	7,240	18,224

a Catch in numbers of fish.
b Preliminary; does not include Old Crow harvest.
c Includes 300 fish from sport fishery.

000833

Appendix Table 5. Alaska catch of Yukon River chum salmon, 1961-1987. a

Year	Summer Chum			Fall Chum			Total Chum		
	Subsistence b	Commercial	Total	Subsistence b	Commercial	Total	Subsistence b	Commercial	Total
1961	305,317		305,317	101,772	42,461	144,233	407,089	42,461	449,550
1962	261,856		261,856	87,285	53,116	140,401	349,141	53,116	402,257
1963	297,094		297,094	99,031		99,031	396,125	0	396,125
1964	361,080		361,080	120,360	8,347	128,707	481,440	8,347	489,787
1965	336,848		336,848	112,283	23,317	135,600	449,131	23,317	472,448
1966	154,508		154,508	51,503	71,045	122,548	206,011	71,045	277,056
1967	206,233	10,935	217,168	68,744	38,274	107,018	274,977	49,209	324,186
1968	133,880	14,470	148,350	44,627	52,925	97,552	178,507	67,395	245,902
1969	156,191	61,966	218,157	52,063	131,310	183,373	208,254	193,276	401,530
1970	166,504	137,006	303,510	55,501	209,595	265,096	222,005	346,601	568,606
1971	171,487	100,090	271,577	57,162	189,594	246,756	228,649	289,684	518,333
1972	108,006	135,668	243,674	36,002	152,176	188,178	144,008	287,844	431,852
1973	161,012	285,509	446,521	53,670	232,090	285,760	214,682	517,599	732,281
1974	227,811	589,892	817,703	93,776	289,776	383,552	321,587	879,668	1,201,255
1975	211,888	710,295	922,183	86,591	275,009	361,600	298,479	985,304	1,283,783
1976	186,872	600,894	787,766	72,327	156,390	228,717	259,199	757,284	1,016,483
1977	159,502	534,875	694,377	82,771	257,986	340,757	242,273	792,861	1,035,134
1978	197,137	1,077,987	1,275,124	94,867	247,011	341,878	292,004	1,324,998	1,617,002
1979	196,187	819,533	1,015,720	233,347	378,412	611,759	429,534	1,197,945	1,627,479
1980	272,398	1,067,715	1,340,113	172,657	298,450	471,107	445,055	1,366,165	1,811,220
1981	208,284	1,196,006	1,404,290	188,525	477,736	666,261	396,809	1,673,742	2,070,551
1982	260,969	614,222	875,191	132,897	224,992	357,889	393,866	839,214	1,233,080
1983	240,386	894,878	1,135,264	192,930	307,662	500,592	433,316	1,202,540	1,635,856
1984	230,747	755,821	986,568	174,823	210,560	385,383	405,570	966,381	1,371,951
1985	264,828	765,622	1,030,450	206,472	270,269	476,741	471,300	1,035,891	1,507,191
1986	290,888	993,160	1,284,048	164,034	140,019	304,053	454,922	1,133,179	1,588,101
1987 c	275,914	521,567	797,481	245,834	0	245,834	521,748	521,567	1,043,315
Average									
1962-66	282,277	--	282,277	94,092	38,956	125,257	376,370	31,165	407,535
1967-71	166,859	64,893	231,752	55,619	124,340	179,959	222,478	189,233	411,711
1972-76	179,118	464,452	643,569	68,473	221,088	289,561	247,591	685,540	933,131
1977-81	206,702	939,223	1,145,925	154,433	331,919	486,352	361,135	1,271,142	1,632,277
1982-86	257,564	804,741	1,062,304	174,231	230,700	404,932	431,795	1,035,441	1,467,236

a Catch in numbers of fish, including "equivalent fish" converted from roe sales.
b Includes small numbers of pink and coho salmon during the period 1961-1976.
c Preliminary.

000834

Appendix Table 6. Canadian catch of Yukon River chum salmon including Porcupine River), 1960-1987. a

Year	Commercial	Non Commercial			Total
		Domestic	Indian Food Fish	Combined	
1960	5,493		10,115	10,115	15,608
1961	3,276		5,800	5,800	9,076
1962	936		8,500	8,500	9,436
1963	2,196		25,500	25,500	27,696
1964	1,929		10,258	10,258	12,187
1965	2,071		9,718	9,718	11,789
1966	3,157		10,035	10,035	13,192
1967	3,343		13,618	13,618	16,961
1968	453		11,180	11,180	11,633
1969	2,279		5,497	5,497	7,776
1970	2,479		1,232	1,232	3,711
1971	1,761		15,150	15,150	16,911
1972	2,532		5,000	5,000	7,532
1973	2,806		7,329	7,329	10,135
1974	2,544	466	8,636	9,102	11,646
1975	2,500	4,600	13,500	18,100	20,600
1976	1,000	1,000	3,200	4,200	5,200
1977	3,990	1,499	6,990	8,489	12,479
1978	3,356	728	5,482	6,210	9,566
1979	9,084	2,000	11,000	13,000	22,084
1980	9,000	4,000	9,218	13,218	22,218
1981	15,260	1,611	5,410	7,021	22,281
1982	11,312	683	4,096	4,779	16,091
1983	25,990	300	3,200	3,500	29,490
1984	22,932	535	5,800	6,335	29,267
1985	35,746	279	5,240	5,519	41,265
1986	11,464	222	2,850	3,072	14,536
1987 b	40,341	132	3,772	3,904	44,245
Average					
1962-66	2,058	--	12,802	12,802	14,860
1967-71	2,063	--	9,335	9,335	11,398
1972-76	2,276	2,022	7,533	8,746	11,023
1977-81	8,138	1,968	7,620	9,588	17,726
1982-86	21,489	404	4,237	4,641	26,130

a Catch in numbers of fish.

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Appendix Table 7. Chinook salmon escapement index counts for selected spawning areas in the Yukon River drainage, 1959-1987. a

	Andreafsky		Anvik							
	E Fork	W Fork	Aerial	Tower	Nulato	Chena	Salcha	Big Salmon	Nisutlin	Whitehorse Fishway
1959										1,054
1960	1,020	1,220	1,950		756	132 b	1,660			660
1961	1,003		1,226		543 b		2,878			1,068
1962	675 b	762 b					937			1,500
1963						137 b				484
1964	867	705					450			587
1965		355 b	650 b				408			903
1966	361	303	638				800			563
1967		276	336 b							533
1968	380	383	310 b				739	827 b	407	414
1969	231 b	274 b	296 b				461 b	286 b	105 b	324
1970	665	574 b	368				1,882	670	615	625
1971	1,904	1,682				193 d	158 b	200 b	650	856
1972	798	582 b		1,198		138 d	1,193	560	237	391
1973	825	788		613		21 b	391	75 b	36 b	224
1974		285		471 b	78 b	1,035 c	1,857	70 b	150 b	273
1975	993	301		730	204	316 c	1,055	153 b	239	313
1976	818	643		1,154	648	531	1,641	86 b	102	121
1977	2,008	1,499		1,371	487 b	563	1,202	316 b	77	277
1978	2,487	1,062		1,324	920	1,726	3,499	524	375	725
1979	1,180	1,134		1,484	1,507	1,159 b	4,789	632	713	1,184
1980	958 b	1,500	1,330		1,323 b	2,541	6,757	1,568	975	1,383
1981	2,146 b	231 b	807 b		791 b	600 b	1,237 b	2,411	1,626	1,539
1982	1,274	851 b				2,073	2,534	757	578	473
1983			653 b		1,006	2,553	1,961	540	701	905
1984	1,573 b	1,993	641 b			501	1,031	1,044	832	1,042
1985	1,617	2,248	1,051		2,780	2,553	2,035	801	409	536
1986	1,954	3,158	1,118		2,974	2,031 b	3,358	745	459 b	541
1987	1,608	3,141	1,174		1,638	1,312	1,898	1,121	275	327

a Data obtained by aerial survey unless otherwise noted. Only peak counts are listed.
b Incomplete survey and/or poor survey timing or conditions resulted in minimal or inaccurate count.
c Boat survey.
d Boat survey that was incomplete or conducted under poor conditions.

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Appendix Table 8. Summer chum salmon escapement population estimates and index counts for selected spawning areas in the Yukon River drainage, 1974-1987. a

	Andreafsky			Anvik				
	E Fork Aerial	E F Sonar or Tower	W Fork Aerial	Tower & Aerial	Sonar	Nulato	Hogatza	Salcha
1974	3,215 b		33,578	201,277		51,160		3,510
1975	223,485		235,954	845,485		138,495	22,355	7,573
1976	105,347		118,420	406,166		40,001 b	20,744	5,474
1977	112,722		63,120	262,854		69,660	10,734	677 b
1978	127,050		57,321	251,339		54,480	5,102	5,405
1979	66,471		43,391		280,537	37,104	14,221	3,060
1980	36,823 b		115,457		492,676	14,946 b	19,786	4,140
1981	81,555	147,312			1,479,582	14,348 b		8,500
1982	7,501 b	181,352	7,267 b		444,581		4,984 b	3,756
1983		110,608			362,912	21,012 b	28,141	716 b
1984	95,200 b	70,125	238,565		891,028			9,810
1985	66,146		52,750		1,080,243	29,838	22,566	3,178
1986	83,931	167,614	99,373		1,189,602	64,265		8,028
1987	6,687	45,221	3,537		455,876	11,257	5,669 b	3,657

a Data obtained by aerial survey unless otherwise noted. Only peak counts are listed.
b Incomplete survey and/or poor survey timing or conditions resulted in minimal or inaccurate count.

Appendix Table 9. Fall chum salmon expanded population escapement estimates for selected spawning areas in the Yukon River drainage, 1974-1987.

Year	Delta a	Upper Toklat b	Sheenjek c	Fishing Branch d	Total
1974	5,915	43,484	89,966	32,525 w	171,890
1975	3,734 p	90,384	173,371	353,282 w	621,371
1976	6,312 p	53,882	26,354	36,584	123,132
1977	16,876 p	36,462	45,544	88,400	187,282
1978	11,136	37,057	32,449	40,800	121,442
1979	8,355	179,627	91,372	113,898	393,252
1980	5,137	26,373	28,933	55,268	115,711
1981	23,508	15,775	74,560	57,386 e	171,229
1982	4,235	3,601	31,421 s	15,901	55,158
1983	7,705	20,807	49,392 s	27,200	105,104
1984	12,411	16,511	27,130 s	15,150	71,202
1985	17,276 p	22,805	152,768 s	56,100 w	248,949
1986	6,703	18,903	83,197 s	31,173 w	139,976
1987	21,180 p	22,141	140,086 s	48,956 w	232,363

a Total escapement estimates made from migratory time density curve (Barton 1986) unless otherwise indicated; (p) population estimate from replicate foot surveys and stream life data.

b Total escapement estimates using Delta River migratory time density curve and percentage of live salmon present by survey date in the upper Toklat River area.

c Total escapement estimates using sonar to aerial survey expansion factor of 2.221 unless otherwise indicated; (s) sonar estimate.

d Total escapement estimates using weir to aerial survey expansion factor of 2.72 unless otherwise indicated; (w) weir estimate.

e Initial aerial survey count was doubled before applying the weir/aerial expansion factor of 2.72 since only half of the spawning area was surveyed.

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